COMPARISON OF EXTERNAL DACRYOCYSTORHINOSTOMY WITH ENDOSCOPIC SURGICAL DACRYOCYSTORHINOSTOMY

Dissertation submitted for
M.S. (Branch III) Ophthalmology

The Tamilnadu Dr. M.G.R. Medical University, Chennai

MARCH 2007

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CERTIFICATE

Certified that this dissertation entitled "COMPARISON OF EXTERNAL DACRYOCYSTORHINOSTOMY WITH ENDOSCOPIC SURGICAL DACRYOCYSTORHINOSTOMY" ***submitted to the Tamilnadu Dr. M. G.R Medical university , Chennai March 2007 is the bonafide work done by Dr. S. TAMILARASI under our supervision and guidance in the Orbit and Oculoplasty department of Aravind Eye Hospitals and Postgraduate Institute of Ophthalmology, Madurai during her residency programme from May 2004 to April 2007.***

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Part – II

INTRODUCTION

Epiphora is a relatively frequent problem encountered in ophthalmology. It may be due to nasolacrimal sac obstruction following an acute or chronic inflammation, trauma, tumour, or congenital malformation. It may be associated with purulent secretion and swelling of the sac region. Although medical treatment including antibiotic therapy, may address the symptoms, definitive management of this problem consists of surgical procedure in which patency of the lacrimal system is restored. The standard surgery for the blockage of the lacrimal outflow is dacryocystorhinostomy, in which the lacrimal sac is connected directly to the nose by removing the layer of bone and mucosa that separate these two structures. The aim of the surgery is at draining the tears freely into the nose with sac mucosa forming part of the lateral nasal wall.

We live in a surgical era which strives towards minimal trauma. Ophthalmology is no stranger to minimally invasive microsurgical techniques. The evolution of lacrimal surgery is a fascinating story. It began thousands of years ago. Around 2250BC, the code of Hamurabi made first reference to surgical treatment of lacrimal fistula/ abscess.

Dacryocystorhinostomy can be done via an external as well as endoscopic route. The traditional approach since 1890 has been the

external DCR. Only in the last two decades has attention turned towards the endoscopic approach. There has been considerable controversy about the effectiveness of endonasal DCR compared with the traditional external DCR. Various success rates have been reported, with most in the region of 80 – 90 % [1, 2]. This success drops to 65 – 80 % range when laser DCR is performed [3-6].This is in contrast to the success rates of external DCR which in the hands of expert reaches 95%[7, 8]. However, newer variations in lacrimal surgery continue to be developed to optimize the treatment of lacrimal disorders. Various surgical techniques must be evaluated and compared using criteria of long term success, rate of complication, patient satisfaction and efficiency of health care delivery. In this study we compare the surgical outcome and complications of external with endonasal surgical DCR.

REVIEW OF LITERATURE

1. Comparison of external DCR with nonlaser, nonendoscopic endonasal DCR. Dolman PJ. Ophthalmology. 2003 Jan; 110(1):78-84.

It was a retrospective, nonrandomized, comparative interventional case series. A total of 354 consecutive cases of DCR performed by one surgeon were reviewed over a 4-year period with a minimum 1 year of follow-up using either external dacryocystorhinostomy(EX-DCR) or endonasal dacryocystorhinostomy(EN-DCR). A total of 153 EX-DCR and 201 EN-DCR patients were identified. Silicone stents were placed for 3 months. Patency of the lacrimal system was assessed by history and irrigation. Outcome was graded as full success, partial success, or failure.Full success was achieved in 90.2% of EX-DCRs and 89.1% of EN-DCRs. Partial success was recorded in 2.0% of EX-DCRs and 4.0% of EN-DCRs. The failure rate was 7.8% for EX-DCR and 7.0% for EN-DCR. There was no statistical significance between these outcomes.Eleven of the failed cases in each group underwent revision EN-DCR surgery, with 90.9% success in each group. Epistaxis occurred in 7(4.6%) EX-DCR patients and 11(5.5%) EN-DCR patients. Wound complications in EX-DCR included bruising in four patients, localized infections in two patients, and punctal eversion in six patients. In EN-DCR, inadvertent incision of the periorbita occurred in five patients. One patient reported

transient diplopia after the medial rectus was inadvertently pulled during an EN-DCR.The study concluded that EN-DCR approach is more rapid than the traditional external approach, has an equivalent surgical success rate and was preferred by patients who had alternative techniques performed on opposite sides.

2. External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in a tertiary referral center. Ben Simon GJ, Joseph J, Lee S, Schwarcz RM, McCann JD, Goldberg RA. Ophthalmology. 2005 Aug; 112(8):1463-8.

It was a retrospective, comparative, nonrandomized clinical study. This study compared success rates of external dacryocystorhinostomy (DCR) and endoscopic endonasal DCR for acquired nasolacrimal duct obstruction. One hundred forty-three patients (176 surgeries) operated for acquired NLDO were taken in this study. Surgical failure was defined as (1) no marked improvement in tearing or any episode of postoperative dacryocystitis, (2) inability to irrigate the lacrimal system postoperatively, and (3) postoperative nasal endoscopy with scarring in the intranasal osteotomy or no visualization of fluorescein dye. Postoperative nasal endoscopy was performed in all failed cases and in >50% of all patients. Success was achieved in 135 cases (76.7%) and failure in 41 (23.3%). Surgical revision was performed in 22 cases (12.5%), but it was successful in

only 9 (5.1%). In this study, endoscopic DCR (86 cases) had a significantly higher success rate than external DCR (90 cases), 84% versus 70% (P=0.03). Complications included epistaxis (1) and sump syndrome (2). It concluded that success rates of revision surgery were relatively low (<50%), and patients who fail the first revision are not likely to benefit from additional revisions.

3. Mechanical endonasal dacryocystorhinostomy versus external dacryocystorhinostomy. Tsirbas A,Davis G, Wormald PJ. Ophthal Plast Reconstr Surg. 2004 Jan; 20(1):50-6.

It was a prospective, nonrandomized interventional comparative case series of 31 consecutive Mechanical endonasal dacryocystorhinostomy (MENDCR) and 24 conventional dacryocystorhinostomy (EX-DCR). Two surgeons performed the MENDCRs, using a standardized operative technique, which involved creation of a large bony ostium and mucosal flaps between the lacrimal sac mucosa and nasal mucosa. One surgeon performed all EX-DCRs. Success was defined as relief of symptoms and by anatomic patency, which was assessed by history, fluorescein flow on nasal endoscopy, and lacrimal syringing.In the MENDCR group, surgery was successful in 29 of 31 DCRs (93.5%); in the EX-DCR group, the success rate was 95.8% (23/24 DCRs). The differences in overall success and anatomic

patency were not statistically significant. He concluded that MENDCR relies on creation of a large ostium and mucosal flap apposition and a larger, randomized prospective trial is needed to fully assess the efficacy of this new technique.

4. External dacryocystorhinostomy.- Surgical success, Patient satisfaction, and Economic cost. Kristin J. Tarbet, Philip L. Custer. Ophthalmology 1995; 102: 1065-70.

This study reviews the demographics, success, cost, efficiency, and patient satisfaction in external DCR. It was a retrospective study in which records of 169 patients who underwent external DCR were reviewed and data of the patient history, surgical record and postoperative success, complication, and follow up were noted. Patient satisfaction was evaluated by telephone survey. Most patients (90%) underwent silicone intubation, with the tubes removed at an average of 3.7 weeks after surgery. A patent system was established in 95% of the procedures, whereas 92% remained asymptomatic. Postoperative complications included haemorrhage (3.9%) and scarring (2.6%). Of the surveyed patients, 87% denied continued symptoms, 97% rated their incision good in appearance and all patient stated they would recommend the procedure to others. They concluded that external DCR is highly successful, requires limited follow up and is a cost effective procedure. Complications are uncommon and patient satisfaction is

high and new lacrimal surgical techniques must be evaluated against the long -proven success of the external approach.

5. Endonasal DCR – A report by the American Academy of Ophthalmology. Ophthalmology 2001; 108:2369-2377.

This document describes endonasal DCR and examines the evidence and answers key questions about the effectiveness of the procedure compared with the external DCR; the relative indications, contraindications, advantages and limitations of the procedure; and patient selection, surgical technique, postoperative care and complications. A literature search conducted for the years 1968 to 2000 retrieved 93 citations. The panel members reviewed 71 of these articles and selected 64 for the panel methodologist to review and rate according to the strength of evidence as level I to III. The published literature included two reports that described clinical trials comparing endonasal with external DCR with a one year follow up. The success rate was 91 % for the external DCR group in both the reports and 83% and 75% for the endonasal DCR groups, defined by patency by irrigation. Remaining data on reported success rates of primary and revision endonasal DCR were obtained from a collection of uncontrolled observational case studies with varying periods of follow up and success rates ranging from 59% to 100%. They concluded that it's difficult to make definitive evidence based determinations about the

relative efficacy of endonasal and external DCR because of the deficiencies in the reported literature. Based on the evidence, the available data suggested that endonasal DCR may be a viable option for the correction of acquired Nasolacrimal duct obstruction and complex forms of congenital dacryostenosis in selected patients. This procedure may be indicated on a primary basis or a revisional surgery following failed external or endonasal DCR. Reported complications of endonasal DCR do not generally appear to be greater in frequency or magnitude than those associated with external DCR. Disadvantages of endonasal DCR include preferred use of general anaesthesia by many surgeons, the high cost of equipment and instrumentation, and the relative steep learning curve for this procedure. Both the advantages and limitations of endonasal DCR relative to external DCR should be carefully discussed with the patients who are contemplating endonasal surgery.

6. ***Dacryocystorhinostomy - state of the art, indications, results.*** Keerl R, Weber R. Laryngorhinootologie. 2004 Jan; 83(1):40-50.

On the basis of an extensive review of the literature they presented an overview of the causes, the necessary diagnostic procedures and the surgical management of lacrimal duct stenosis. The results published for endonasal DCR were slightly worse than those for the external DCR. The success rates were around 90 %. Laser-assisted

DCR and endoscopic dacryoplasty do not currently appear to yield better results than the conventional methods. Postoperative care after endonasal DCR should consist of removal of fibrin, crusts and granulations and administration of eye drops (antibiotic + cortisone) and nasal steroids to prevent synechiae formation. Neither silicone stenting nor the application of mitomycin C are routinely indicated. They concluded that with appropriate operative technique and in experienced hands, the success rates of endonasal DCR were practically equal to those of the classical external approach.

7. A consideration of the time taken to do DCR surgery.

Malhotra R, Wright M, Olver JM. Eye, 2003 Aug; 17(6):691-6.

This prospective study compared the surgical times for dacryocystorhinostomy (DCR) by three different approaches :(1) external,(2) endoscopic endonasal surgical (EES), and (3) endoscopic endonasal laser (EEL) using the holmium:YAG laser. A total of 48 patients undergoing 51 DCR procedures were studied. The mean surgical time for primary external (n=20), EES-DCR (n=16), and EEL-DCR (n=15) was 41.1+/-10.3, 39.6+/-13.8, and 20.9+/-7.8 min, with symptomatic success achieved in 95, 88, and 60%, respectively. They concluded that there was no significant difference between the time taken to do EES-DCR compared to external DCR, and their clinical outcomes. Only EEL-DCR was significantly faster ($P<0.001$). However,

its lower success rate negates the apparent benefit from the greater surgical throughput.

8. Outcome of patients treated with the endoscopic DCR. Haque MR, Hossain MM, Halder KK, Kundu SC, Morshed Z, Chowdhury WA. Mymensingh Med J. 2004 Jul; 13(2):157-60.

They performed 50 DCRs by endonasal endoscopic approach.The age range of patient was found between 7 to 35 years (average 21 yrs) Male to female ratio was 1:1.5. Associated nasal disease correction (septoplasty) was done in 7 cases. In each & every case silicon tube was introduced & removed after 3 to 6 months. The only complication was periorbital injury in 5 cases, punctal tear in 2 cases and granuloma formation in 2 cases. Overall success rate was 86%.

9. Tips on how to avoid the DCR scar. Olver JM. Orbit. 2005 Jun; 24(2):63-6.

In this study they discussed the simple measures to avoid a scar which included the use of local anaesthesia, location of the incision, maintaining a bloodless surgical field, using a skin flap technique and simple orbicularis and skin wound closure. They concluded that although endonasal endoscopic dacryocystorhinostomy is gaining clinical acceptance and popularity, the external dacryocystorhinostomy is regarded as the gold standard in terms of surgical success, with a high patient satisfaction.

10. Endoscopic endonasal management of prolapsed silicone tubes after dacryocystorhinostomy. John L. Brookes, Jane M. Olver. Ophthalmology 1999; 106: 2101-2105.

This study was done determine the incidence of tube prolapse after DCR, review the methods used to reposite them, and identify the optimum management. It was a retrosepective, noncomparative, interventional case series. A total of 205 adult patients who had DCR with intubation were studied. Patients with spontaneous tube loss or prolapse were identified from clinical attendance and case note reviewed. Five (2.5%) had tube loss or prolapse or both, all with in the first month after surgery. The tubes were repositioned initially in four patients, but prolapse recurred in two patient's necessitating further intervention. Only nasal endoscopy enabled precise tube visualization and manipulation with eventual tube stability.They concluded that tube prolapse is rare after DCR surgery. The tubes can be pushed back in, but prolapse may recur unless the endonasal aspect is addressed. The position of the tie or knots should be inspected endonasally and the tubes further secured if indicated.

ANATOMY

Lacrimal drainage system helps in drainage of tears from conjunctival sac to nose thus maintaining a constant flow of tears. It

has membranous and osseous part [9-11]. ***Bony parts*** are made up of lacrimal fossa and nasolacrimal canal. ***The membranous part*** consist of two punctae, two canaliculi, a common canaliculus , a lacrimal sac and a nasolacrimal duct which opens into the inferior meatus of the nose.

BONY PASSAGE:

Lacrimal Fossa:

It lodges the lacrimal sac. It is formed by frontal process of maxilla anteriorly and lacrimal bone posteriorly. It measures 16mm vertically, 8 mm antero posteriorly and 2- 4 mm deep. It's bounded in front by anterior lacrimal crest formed by maxilla which continues downward with inferior orbital margin, and behind by posterior lacrimal crest formed by lacrimal bone which continues upward with superior orbital margin. Maxillary bone is very strong but lacrimal bone is thin especially in its posterior half.

Nasolacrimal canal:

It extends from lacrimal fossa to inferior meatus and it descends postero laterally. It is formed mainly by the maxilla and it is completed

by the lacrimal bone and the lacrimal process of the inferior nasal concha.

MEMBRANOUS PASSAGE:

The Puncta:

Each punctum lacrimale is a small, round or oval orifice on the summit of an elevation, the papilla lacrimalis near the medial end of the lid margin at the junction of its ciliated and non ciliated parts. The upper punctum is slightly medial to the lower, respective distances from the medial canthus being 6 and 6.5 mm. It is 0.2 to 0.3 mm in diameter. The punctae are relatively avascular and thus paler than surrounding area. Upper punctum opens infero posteriorly and lower supero posteriorly, hence normal puncta are visible only when lids are everted. Patency of punctum is maintained by surrounding dense fibrous tissue continuous with the adjacent tarsal plate. Fibres of orbicularis also press the punctum towards lacus lacrimalis.

The Lacrimal Canaliculi:

The canaliculus is first vertical and then horizontal – Facts of importance in passing a probe. The vertical part is 2 mm long and turns medially roughly at right angles to become the horizontal part almost 8 mm in length and 0.5 mm in diameter. At the angle is a dilatation or ampulla. Both horizontal parts converge towards the

medial canthus, uniting to enter a small diverticulum of the sac called ***the lacrimal sinus of Maier*** at a point on posterolateral surface of the sac about 2.5 mm from its apex. The short common canaliculus is 0.5 mm long. Canaliculi lie behind the medial palpebral ligament (MPL) and are surrounded by the fibres of pars lacrimalis of the orbicularis muscle.

Lacrimal Sac:

The lacrimal sac is located in the lacrimal fossa located on the anterior part of medial orbital wall. It measures 12-15 mm in length, 4-6 mm antero posteriorly and 2-3 mm wide. The part of the sac above opening of common canaliculus is called *fundus* and that below is *body*. The sac is closed above and opened below and is continuous with nasolacrimal duct.

Sac is enclosed by a periorbita which splits at the posterior lacrimal crest, encloses the sac, reuniting at the anterior crest and thus forms the lacrimal fascia. This fascia is separated from the sac by areolar tissue containing a fine plexus of vein continued around the duct.

***Relations*:**

1. Medially – Anterior ethmoid sinus above, nasal middle meatus below.
2. Laterally – skin, parts of orbicularis oculi, lacrimal fascia – attached to which are a few fibres of inferior oblique.
3. Anteriorly – MPL, Angular vein
4. Posteriorly – Lacrimal fascia, muscles, septum orbitale, check ligament of medial rectus.

Angular vein complicates the surgical approach to the lacrimal sac. It crosses the ligament subcutaneously 8 mm medial to medial canthus. Sometimes a tributary crosses the ligament between the medial canthus and the parent vein. So incision for removal of the sac should not be more than 2-3 mm medial to medial canthus.

Nasolacrimal Duct:

The nasolacrimal duct is 18 mm in length. It connects the lower end of the lacrimal sac with the inferior meatus of the nose. It has two parts.

a) Upper intra osseous part lying in nasolacrimal canal is 12.5 mm long
b) Lower intra meatal part lying within the mucous membrane of lateral wall of nose is 5.5 mm long.

It is directed downward, backward, laterally. Nasolacrimal duct opens below into the anterior part of the inferior meatus of the nose approximately 10 mm posterior to the anterior end of the inferior turbinate and approximately 30 mm from the external nares (in adult). A mucous membranous ridge known as the ***valve of Hasner*** is present at the opening of the duct and functions to prevent reflux of air or nasal discharge into the nasolacrimal system.

Valves in Lacrimal Apparatus:

1. At junction of punctum and canaliculi- *valve of Bockdelek*
2. In the vertical limb of lacrimal canaliculi – *valve of Foltz.*
3. At junction of canaliculi with sinus of Maier – *valve of Rossenmuller.*
4. At the same place medially – *valve of Huschke* .
5. In the course of NLD- *valve of Beraud* or *valve of Krause, valve of Taillefer.*
6. *Valve of Hasner, Cruveilhier.*

ARTERIAL SUPPLY:

The arteries are branches of

1. Medial palpebral artery from the ophthalmic artery,
2. The facial artery,
3. Infraorbital from the maxillary artery,

4. Sphenopalatine artery from the maxillary artery.

VENOUS DRAINAGE:

Drains into:

1. Angular and infraorbital vessels above and to
2. Nasal veins below.

NERVE SUPPLY:

1. Infratrochlear branch of the ophthalmic division of trigeminal nerve.
2. Anterior superior alveolar, a branch of the maxillary division of trigeminal nerve.

LYMPHATICS:

Pass to the submandibular and deep cervical lymph nodes.

ANATOMY OF LATERAL NASAL WALL

The lateral wall of each nasal cavity [12] is convoluted in appearance due to the three conchae or turbinates below which corresponding meatus is situated . The nasolacrimal duct opens into the anterior end of inferior meatus.

The middle meatus contains the uncinate process, hiatus semilunaris (with the infundibulum) and ethmoid bullae. The uncinate process is a smooth mucosal elevation in the anterior part of middle meatus. Usually lacrimal sac and the duct lie immediately anterior and lateral to it and it need not be disturbed during surgery. It is a useful landmark during endonasal surgery. Its superior posterior free margin borders the hiatus semilunaris which is a crescent shaped cleft leading to infundibulum into which frontal, anterior ethmoid and maxillary sinus drain. The hiatus is situated between the uncinate process and the ethmoid bullae. The ethmoid bulla is a thin walled bony prominence representing the largest and the most consistent air cell of anterior ethmoid complex. The posterior ethmoid sinus drain into superior meatus and sphenoidal sinus communicates with spheno ethmoidal recess.

The relation of the lacrimal sac to the lateral nasal wall is variable which is due to different sized nasal spaces and midface bony development.

PHYSIOLOGY OF LACRIMAL PUMP

Adequate tear drainage depends on a functioning lacrimal pump mechanism [13-15] initiated by the normal eyelid blink cycle. Approximately 25% of the secreted tears is lost to the process of evaporation. The remaining 75% is pumped into the nasal cavity through the lacrimal drainage systems. The tears secreted into the superotemporal fornix become part of the tear film of the lower eyelid through gravitational flow and the movement of the upper eyelid.

In most age group, the lower canaliculus is responsible for the drainage of approximately 60% of the tear volume. However, when the lower canaliculus is abnormal, the upper canaliculus is capable of draining sufficient tears to avoid overflow tearing in approximately 90% of people.

PASSIVE DRAINAGE:

From the lacrimal lake there is a continuous low rate of tear drainage into both puncta when the eyelids are not blinking, due to capillary action and the normal eyelid downhill slope.

ACTIVE DRAINAGE:

From Lacus Lacrimalis to Puncta:

Blinking not only spreads the tears over the cornea, but also moves the tear towards the puncta.The firm fixation of the orbicularis

muscle at the anterior and posterior insertion of medial palpebral tendon results in a medial displacement of the upper and lower eyelid with each blink. With each blink upper and lower eyelid approximate first in the lateral canthal area and then proceed toward the medial canthal area. These two physiologic movements promote medial displacement of the tear film towards the lacrimal puncta.

From Puncta to Sac:

As tears enter the lacrimal puncta, they are pumped through the canaliculi into the lacrimal sac by blinking movement[16].

1. The pretarsal orbicularis muscle[17,18] which surrounds the horizontal portion of the canaliculus, causes the puncta to be displaced medially, closure of ampulla and medial displacement of horizontal segment, pumping tear into sac.
2. When the orbicularis muscle contracts,the posterior insertion of orbicularis muscle into the fascia surrounding the lacrimal sac causes lateral displacement of the lateral wall of the sac.This creates a negative pressure within the lacrimal sac that drains the tears from the common canaliculus into the lacrimal sac.

From Sac to NLD:

When the orbicularis muscle *relaxes*, the sac collapses, driving the accumulated tears into the NLD.

Thus the lacrimal drainage system is physiologically composed of a ***canalicular pumping mechanism*** **and a** ***lacrimal sac siphoning mechanism***[19-21]. The membranous portion of the NLD plays little or no role in the active transport of tears from the sac into the NLD.

CAUSES OF EPIPHORA

Epiphora or tearing is an extremely common ocular symptom. A host of disease entities can lead to this symptom. The first step in understanding epiphora is to differentiate epiphora from lacrimation.

Epiphora is watering that occurs secondary to abnormal excretory system in the presence of normal tear secretion. ***Lacrimation*** on the other hand is watering that occurs secondary to excessive tear production in the presence of a normal excretory system.

Causes:

An anatomical classification[22-26] helps to develop a systematic approach to the examination and choice of surgery.

- **Lacrimal Pump, Eyelid, Puncta and Conjunctiva :**

  1. Horizontal lid laxity [27]- floppy eyelid, lax eyelid syndromes and involutional ectropion and entropion .
  2. Lower lid ectropion – involutional, mechanical due to tumours or cicatricial.
  3. Conjunctivochalasis[28].
  4. Allergic conjunctivitis.
  5. Congenital agenesis [29] or imperforate punctum.
  6. Acquired occlusion or stenosis[30].
     - dry punctum from non use in chronic ectropion.

- Post infection.
- Post irradiation.
- Pharmacological – topical antiviral – idoxuridine, Antiglaucoma (phospholine iodide), systemic 5- FU.
- Ocular cicatricial pemphigoid, Stevens Johnson syndrome
- Burns.
- Tumour- ampullary mucosal papilloma.
- Punctal occlusion for dry eye.

7. Malposition of punctum
   - Punctal medial displacement.
   - Medial ectropion.
   - Centurion syndrome – anterior displacement of medial canthal tendon on maxilla.

- **Canaliculi, Sac and Nasolacrimal duct:**

1. Congenital absence [31] or fistula of canaliculi.
2. Acquired causes
   - Post herpetic infection (HSV and VZ)
   - Infective canaliculitis.
   - Trauma, including surgical.
   - Post irradiation [32, 33].
   - Pharmacological [34] – as for puncta.

- Tumours [35] – Intrinsic or extrinsic compression or invasion and occlusion by adjacent tumours eg. Basal cell carcinoma, Squamous cell carcinoma, Lymphoma, Neurofibroma.

3. Obstruction of common canaliculus.
4. Diverticulum or outpouching of sac.
5. Fistula [36] from sac to nose or cheek.
6. Trauma.
7. Inflammation.
   - Extension of Primary acquired nasolacrimal duct obstruction and dacryoliths.
   - Wegeners granulomatosis.
   - Sarcoidosis.
   - Allergy / Hay fever.
8. Tumours
   - Extrinsic- compression or invasion by Basal cell carcinoma, Squamous cell carcinoma, Lymphoma, Neurofibroma.
   - Intrinsic – epithelial – Papilloma, Carcinoma.
   - Non epithelial – Lymphoma, Melanoma, Leukemia, Metastasis, Hemangioma, Neurofibroma.
9. Primary acquired nasolacrimal duct obstruction.

10. Secondary acquired nasolacrimal duct obstruction [37].

11. Congenital nasolacrimal duct obstruction [38].

- **Nasal Causes :**

1. Allergic rhinitis.

2. Polyps.

3. Iatrogenic – from previous nasal surgery [39, 40].

4. Tumours – Spread to sac, NLD from nasal space.

EVALUATION OF EPIPHORA

HISTORY TAKING:

Clinical evaluation of epiphora[41-46] begins with accurate history taking incorporating the patient's symptoms, past ophthalmic, nasal and medical histories and history of allergy and drug intake.

Patient with epiphora commonly have 'excess of tears' as their only symptom. Patient should be questioned about intermittent redness of eyes, mucous production or sticking of lids in morning, pain or swelling in the region of lacrimal sac or prior episode of acute dacryocystitis.

Past ophthalmic history includes history of prior viral infection like herpes simplex which may produce canaliculitis simultaneously with keratoconjunctivitis. Bacterial infection more frequently results in nasolacrimal and canalicular obstruction. Staphylococcus aureus is the most common causative pathogen. Actinomyces, a filiform bacterium, may provoke a unilateral conjunctivitis with "sulfur granules" obstructing either the canaliculi or the lacrimal sac. Fungi such as candida also may be found in concretions. They produce softer "cheesier" dacryoliths than those caused by Actinomyces. Past history of repeated probing which can lead to severe canalicular stenosis should be noted. Medial canthal tendon radiation frequently produces canalicular stenosis or obstruction.

Past nasal history include history of nasal polyps that compromise nasal drainage. Prior history of surgery (nasoantral window- placed inappropriately may damage lower portion of NLD) or trauma which may damage canaliculi or NLD.

Past medical history includes history of facial nerve palsy, dysthyroidism, Sjogrens syndrome,Scleroderma, history of allergy either seasonal (hay fever) or environmental (strong perfume) which may produce tearing . Chronic use of topical miotics such as phospholine iodide, antiviral drugs and topical chemotherapeutic agents may produce canalicular stenosis or obstruction.

Family history - may reveal absent or accessory canaliculi in relatives. The lacrimal anlage duct syndrome may be dominantly inherited.

EXAMINATION:

The lacrimal examination consists of three parts

A. Periorbital, lid and lacrimal system assessment

- Observe the face including forehead, cheeks, the periorbital, medial canthal areas and the eyelids.
- Do a slit lamp examination of the puncta and external eye and measure the tear meniscus.
- Perform dye tests.
- Syringe the lacrimal system.

B. Nasal examination

- Do an endonasal examination with a rigid endoscope to exclude nasal causes of epiphora and to identify the anatomic variations that may influence the outcome of surgery.

C. Radiology

Do the following ancillary radiological investigation as indicated.

- Macro dacryocystography
- Nuclear lacrimal scintigraphy
- CT or MRI of the lacrimal system and sinuses.

The finding from this standard approach will differentiate epiphora from hypersecretion of tears and locate the most likely site and cause of epiphora.

A. PERIORBITAL, LID AND LACRIMAL SYSTEM ASSESSMENT:

- Look for facial and periorbital asymmetry, lumps, midface ptosis, and eyelid malposition
- Skin – colour and texture
- Medial canthal area assessment
  - look for lumps, fistulae, inflammation and discharge *(Lacrimal sac swelling arise below the MCT)*

- Anterior lamella shortening or vertical eyelid tightness
    - Examine the tightness of the anterior lamella (skin and muscle) to exclude causes of cicatricial ectropion. A short anterior lamella pulls the lid down and out. Check this by asking the patient to open the mouth widely and look up at the ceiling, if the anterior lamella is short, the ectropion will be exacerbated.
- Puncta and canaliculi
    - Puncta should face slightly towards the lacrimal lake.
    - Look for all four puncta – it's presence and opening.
    - Examine the relative position of upper and lower puncta to each other and to the caruncle.
    - Exclude Stenosis, membrane occlusion, conjunctivochalasis.
    - Examine the caruncle, look for discharge from puncta.
    - If there is chronic red swelling medial to puncta, exclude actinomycosis or fungal infection.

Diagrammatic Record of Periocular, Eyelid and Puncta Assessment

- Superimpose lid malposition and any lumps over a simple line drawing of lids, puncta and MCT.

- Record the location of mass in relation to MCT and use reproducible symbols to represent the finding.

ASSESMENT OF INVOLUTIONAL ECTROPION:

Involutional ectropion progresses from punctual eversion to involve the medial third and then the medial half of the lower lid. Eventually a total ectropion can develop. It is assessed by,

a. Horizontal lid laxity [47] :

The degree of horizontal lid laxity is estimated by the ***pinch test***. Using the thumb and index finger, pull the lid firmly away from the globe and measure the distance between the lid and the eye. It's graded as follows-

None	-	5mm
Minimal	-	5-7mm
Mild	-	8-9mm
Moderate	-	10-12mm
Severe	-	>12mm

The snap – back test is a dynamic test for lower lid tone. The lower lid is pulled down and away from the globe and then released. The speed with which the lid settles back against the globe is observed, as well as whether there is a short gap between the lid and globe once settled and before the first blink is also noted.

b. MCT Laxity

The lower puncta should lie at the plica at rest and should remain there when the lid is pulled laterally. (Lateral distraction test). Up to 1-2 mm movement is normal in a young adult and up to 3-4 mm in elderly. If the punctum can be distracted beyond a line perpendicular to the medial limbus, the MCT is lax and stabilization or other medial canthal surgery should be considered, where the lid is shortened horizontally.

MCT Laxity Grading:

It is based on usual scale in which the position of the punctum is recorded in relation to ocular surface landmarks both at rest and with the *Lateral Distraction Test*.

Steps:

1. Sit opposite to the patient at a distance equivalent to arms length with eye level.
2. Ask the patient to look at the bridge of your nose or glasses.
3. Ensure that you do not induce accommodative convergence by moving too close and check that the patient doesn't have strabismus by doing a cover test.

4. Observe the resting position of the lower punctum in relation to the upper punctum whether medial, in the same vertical line or lateral. The normal lower punctum resting position is situated at the lateral border of the plica and this position is grade 0. Note that the plica extends laterally in its lower part.

5. Firmly pull the lower lid laterally (*lateral distraction test*) and observe the position along the horizontal axis that the punctum reaches. Record the finding in relation to the plica, medial limbus, pupillary line and lateral limbus.

Resting Grade- Lower Punctal Resting Position

-1	-	Punctal medialization
0	-	Normal
+1	-	Midway between the plica and medial limbus
+2	-	In line with medial limbus
+3- +6	-	Beyond the limbus. These position rarely occur

Grading MCT Laxity – Lateral distraction test

0	-	No distraction
+1	-	Punctum reaches midpoint of plica to medial limbus
+2	-	Punctum reaches medial limbus

+3 - Punctum reaches midpoint of medial limbus to pupil line

+4 - Punctum reaches pupil line

+5 - Punctum reaches midpoint of pupil line to lateral limbus

+6 - Punctum reaches lateral limbus

PRESSURE OVER THE SAC:

It is a quick and simple confirmatory test. Regurgitation of mucous or clear fluid or pus through the canaliculus - indicative of obstruction in NLD / Sac

SLIT LAMP EXAMINATION:

Tear meniscus [48]

- Measure the vertical height of the tear meniscus prior to instillation of eye drops. Record the finding diagrammatically and numerically.
- The tear meniscus finding must be considered along with other findings such as FDDT and syringing and not alone.
- When examining the tear meniscus , exclude blepharitis , dry eye and other external disease as a cause of hypersecretion and possibly elevated tear meniscus.

FLUORESCEIN DYE TEST:

FDDT [49-52]

This is a semi quantitative test for delayed or obstructed tear outflow. Instil one drop of fluorescein 2% into the unanesthetized conjunctival sac. The amount of residual colour after 3 and 5 min in one or both eyes is noted and the intensity of residual dye graded. The dye normally drains down the system in this time. The test is positive if residual fluorescein is present. A strong positive is found if obstruction is present.

Grade using scale - 0 - 4 (0 – no dye, 4 - all dye)

False negative - Large lacrimal sac or mucocele, distal NLD block, where the dye can pool in the sac /duct

JONES TESTS:

Jones tests [53] are only performed to confirm and localise functional epiphora. They are not done if there is a complete obstruction on syringing. They are used in conjunction with FDDT, probing and irrigation and can help to differentiate hypersecretion and epiphora.

Steps for Jones I Test

1. Patient is seated with the eyes unanaesthetized to allow normal blinking.
2. Decongest / anaesthetise the nasal mucosa.

3. Instil 2% fluorescein drops into conjunctival sac.
4. Place a cotton bud in the nose below the inferior turbinate as far as the NLD opening (1cm behind the anterior end of the inferior turbinate).
5. The test is positive if dye is found on cotton bud.
6. The test is negative if no dye is recovered from the nose.

Interpretation :

1. Positive Jones I test - Patent drainage system. It is of little value. Epiphora could be from hypersecretion or functional.
2. Negative Jones test - An obstruction of nasolacrimal system may be present and hence Jones II test is recommended
3. Jones I – have unacceptably high false negative – since dye transit time being influenced by patient position, blink rate, gravity, fluorescein volume, nasal floor and inferior turbinate anatomy.

Steps for Jones II test

1. Wash out any residual fluorescein from the conjunctival sac with saline.
2. Instil topical anesthesia .
3. Patient is seated with head tilted forwards.

4. Do transcanalicular irrigation with saline. Ask the patient to blow or spit the fluid onto a tissue paper. Look to see if residual fluorescein from Jones I test is present - Positive result.

Interpretation:

1. Positive Jones II - Confirms anatomical patency with a high pressure wash out of fluorescein. There is a physiological or partial anatomical block below the sac
2. If both Jones I and Jones II tests are negative – High grade functional stenosis is present and surgery is indicated.
3. If clear fluid is irrigated - Indicates that fluorescein did not get into the lacrimal sac with Jones I test. There may be eyelid malposition, lacrimal pump failure (paralytic or punctal or canalicular stenosis).

Modifications of Jones I test:

1. Oropharynx Dye Appearance Test:

This is useful for infants where syringing requires sedation or GA. Instil 2% fluorescein into the conjunctival sac and use a blue light to look at the oropharynx for fluorescein at intervals for up to 30 min. Only one side should be tested at a time for accurate localisation.

2. Taste Saccharin Test [54]:

Instil 0.4 ml of 2% saccharin drops into the conjunctival sac. 90% of patients taste it by 15min. It is best to do one side at a time.

3. Endonasal Dye test [55]:

They are increasingly replacing the Jones I test.

PROBING AND SYRINGING:

It [56-58] detects both the presence and site of partial or complete lacrimal outflow obstruction.

Procedure:

Under topical anaesthesia, dilate the lower punctum with a Nettleship punctum dilator, first vertically and then horizontally, with the eyelid on stretch. Gently insert the blunt tipped lacrimal cannula on a 2ml saline filled syringe into the lower punctum and advance it following the contour of the canaliculus. An attempt is made to enter the lacrimal sac, the medial wall of which lies against the bone of lacrimal fossa. The cannula can come either to a ***hard stop*** or to a ***soft stop.***

Hard Stop

A hard stop occurs if the cannula enters the lacrimal sac. It stops at the medial wall of the sac, through which the rigid lacrimal bone can be felt. This excludes complete obstruction of the canalicular system.

Withdraw back into the sac by 1-2mm and irrigate. This is ***Intrasac irrigation.***

Interpretation:

1. If the saline passes into the nose, the patient has a patent lacrimal drainage system (However it may be stenosed or there may be subtle lacrimal pump failure)
2. Failure of saline to reach the nose is a indication of *total obstruction of the NLD*. Lacrimal sac will become distended during irrigation and there will also be reflux through upper punctum which may be clear, mucoid, mucopurulent or purulent.

Soft Stop

It is experienced if the cannula stops at or proximal to the junction of the common canaliculus and the lacrimal sac. It is recognised as spongy feeling as the cannula presses the soft tissue of the common canaliculus and the lateral wall against the medial wall of the sac and the lacrimal bone behind it.

Interpretation:

1. The sac will not distend
2. In case of *lower canalicular obstruction,* these will be reflux of saline through the lower punctum.

3. Reflux through the upper punctum indicates – patency of both upper and lower canaliculi- but *obstruction of the common canaliculus*.

NASAL EXAMINATION [59]

- Look for any deviation from normal nasal anatomy like septal deviation, middle turbinate variation, uncinate process variation
- Detect nasal pathology like rhinosinusitis, granulomatous diseases, polyps, tumours.
- Findings are recorded on a skeleton diagram showing the key features on the lateral nasal wall and the septum.

RADIOLOGY

This method [60-62] is helpful in finding

1. Exact site of obstruction.
2. State of duct or sac.
3. Size of sac.
4. Type of block – either functional or obstructive.
5. Presence of any diverticula or fistula.
6. Presence of polyps or tumour in sac.

DACRYOCYSTOGRAPHY [63-67]**:**

- Indicated if there is proven block on syringing.

- Enables accurate assessment of the anatomy of the canaliculi, sac and NLD.
- Good for determining the site of stenosis or obstruction.
- It outlines diverticula and fistula and shows intrasac pathology (dacryolith or tumours) and sac size.
- Helps to define the cause of failed lacrimal surgery.

Procedure

1. The inferior punctae are dilated with Nettleship punctum dilator.
2. Plastic catheters are inserted into the inferior canaliculi on either side.
3. Intra canalicularly 2 ml of contrast is injected and PA radiographs are taken at 30sec, 2 min, 5min and later erect film (at 12 - 15min) to assess the effect of gravity on tear drainage
4. Best to do bilateral simultaneous DCG as this gives relative functional information. Digital subtraction DCG provides a high quality images with patient in supine position.

Interpretation

1. Failure of dye to reach the nose indicates anatomical obstruction
2. Normal DCG in presence of epiphora indicates either partial obstruction or lacrimal pump failure.

NUCLEAR LACRIMAL SCINTIGRAPHY [68-70]**:**

Scintigraphy is useful in assessing the site of delayed transit (functional epiphora) when syringing is patent. This uses a radiotracer (technitium 99 m pertechnetate) which is instilled into the conjunctival sac as a drop (10 microlitre) by a micropipette with the patient sitting next to the scintillation (gamma) camera. Tracer activity in the lacrimal system is recorded at intervals through the pinhole collimeter. Images are taken immediately, then at 5,10,15,20 and 25 min for qualitative analysis. Quantitative analysis (region of interest) is available, which will give percentage drainage with time.

Advantages

- Safe physiological method of evaluating lacrimal drainage.
- No topical anaesthesia is required.
- Normal blinking is allowed.

USG:

It is useful in demarcating inflammation, stenosis, fistula, neoplasm and assessment of results after treatment. It is also useful in demonstrating functional ability of lacrimal passage.

CT:

It is only recommended in some patients where tumour, trauma or sinus disease is suspected.

HISTORY OF DCR SURGERIES

Around 2250 BC, the code of Hamurabi made first reference to surgical treatment of lacrimal fistula or abscess. In 25 BC to 50 AD, Celasus from Rome treated lacrimal fistula with excision, cautery and burning. In 1730, Anel recommended probing of the nasolacrimal duct followed by irrigation. About 1724, Wool rouse, an English surgeon practicing in Paris seems to have been the first to try a short circuit from the lacrimal sac to the nose by excising the sac, piercing the lacrimal bone with a trocar and inserting a drain through this opening. In 1724, Platner described a technique of treating chronic dacryocystitis. In 1735, Monro exposed the lacrimal sac and passed a shoe makers awl down the nasolacrimal duct followed by a seton which was left in place. In 1836, Montain first described the use of a perforating trephine in the treatment of lacrimal fistula. In 1851, Bowman was the first to show that the puncta and canaliculi could be dilated for the passage of the nasolacrimal duct probes of graduated

sizes. In 1868, Berlin excised the lacrimal sac. In 1891, De Wecker performed partial dacryoadenectomy for epiphora. In 1897, Kyle described a procedure for chronic dacryocystitis.

Modern surgery of the lacrimal sac[71] began in Italy in 1904, with Toti's description of an operation which involved creation of an opening into the nasal wall with hammer and chisel, removal of the nasal mucosa in the opening and the medial half of the lacrimal sac. In 1912, Blascovics used the Toti's technique but removed the entire lacrimal sac except for a small portion surrounding the opening of the canaliculi. In 1914, Kuhn cut the nasal mucosa in horseshoe fashion, leaving it attached anteriorly and suturing it to the periosteum anterior to the bony opening. In 1921, Mosher combined the Toti's technique with intranasal removal of the tip of the middle turbinate and suturing of the anterior border of the opening in the lacrimal sac to the tissues anterior to the bony opening. In 1920 and again in 1922, Dupuy-Dutemps and Bourguet in France and in 1921, Ohms working independently in Germany modified the Toti's technique by dissecting the anterior and posterior flaps of the nasal and lacrimal mucosa and then suturing the flaps together. In 1925, Basterra modified the Dupuy-Dutemps technique by dissecting an anterior flap of nasal mucosa and suturing it to the anterior border of the opening in the lacrimal sac. In 1944, Soria recommended suturing single flap of nasal mucosa to the

posterior flap of the lacrimal sac and suturing the anterior flap of the sac to the anterior border of the bony opening. In 1911, Forsmark; in 1934, Stock and in 1944, Gifford recommended transplantation of the lacrimal sac. In this technique, the sac is severed from the nasolacrimal duct at its junction after which its lower end is pulled into the bony nasal opening by sutures brought out through the nostril. In 1946, Arruga described a technique for dacryocystorhinostomy applicable to the patients who had previously undergone dacryocystectomy. In 1954, Illiff suggested that the stryker saw can be used to open the lateral bony nasal wall. In 1957, Lester Jones described the use of a pyrex tube passed from conjunctival sac to the nasal cavity for cases of total canalicular block. In 1960, Barrie Jones described a number of elegant operations for complex obstructions of lacrimal drainage. In 1973, Barrie Jones summarized the principles of the lacrimal surgery.

ENDONASAL DCR:

Endonasal DCR was first proposed by Caldwell in 1893[72]. Caldwell used an electric burr to create a middle meatal osteotomy in the area marked by a metal probe. This probe was passed through the nasolacrimal duct to identify the area of blockage. The technique was modified by West in 1914[73], who introduced the idea of a window osteotomy by removal of the lacrimal bone and the superior maxilla to

access the nasolacrimal duct. However the popularity of endonasal DCR did not increase until the 1970 & 1980s. The first clinical study of ***Endoscopic surgical DCR*** was published by McDonough and Meiring in 1989 [1]. With the introduction of operating microscopes, rigid and semi rigid nasal endoscopes, and fibreoptic delivery systems, evaluation of intranasal anatomy become easier. Prior to these advances, the endonasal technique was limited due to poor visualisation and illumination in the superior nasal cavity and bleeding of the nasal mucosa. In 1990[74], ***Endonasal laser assisted DCR*** was introduced by Massoro et al in a Cadaveric study using the argon blue green laser for bone removal. Initially, this procedure was described as using a laser to burn the mucosa and remove the bone and in the past few years, a variety of lasers with different wavelengths have been tried, including high powered blue – green argon; potassium – titanyl-phosphate (KTP) and carbon di oxide (Gonnering et al [75]) ; and holmium yttrium – aluminum – garnet lasers (Woog et al [76]). Levin and Stormogipson [77] introduced endocanalicular laser assisted DCR in cadaveric specimens.These lasers are expensive to purchase and maintain, require setup time and safety precautions, and generate char around ostium site, necessitating frequent lavage and debridement in the postoperative period. Now with simpler instruments and avoiding

expensive lasers the technique of non laser endoscopic DCR is being done all over.

THE CHOICE OF SURGERIES

There are two main types of DCR; External and Endonasal. They are different surgeries, with different success rates. It is important to explain to patients the pros and cons of different type of DCR surgeries and their relative success rate.

TYPES OF DCR:

I. External DCR:

INDICATIONS : 1) For symptomatic epiphora in patients with complete nasolacrimal duct obstruction 2) Acute or chronic dacryocystitis. 3) Dacryolith or lacrimal sac tumors and lacrimal sac mucocele. 4) Incomplete nasolacrimal duct obstruction or flaccid lacrimal passages as suggested by Jone's testing or dacryoscintigraphy. 5) After incisional surgery into the lacrimal sac for removal of a foreign body. 6) Chronically discharging lacrimal fistula. 7) Children who have recurrent dacryocystitis after several probings

and lacrimal intubations. 8) As a preliminary procedure to the placement of a Jone's tube in conjunctivo dacryocystorhinostomy. 9) As an operative component in the repair of common canalicular laceration or stenosis.

In this procedure [78-81], the lacrimal sac and the nasal mucosa are approached via a skin incision (either vertical or curved) made 10 mm medial to medial canthus avoiding the angular vein. Blunt dissection is made till anterior lacrimal crest is seen. The periosteum is elevated and a large bony rhinostomy is made between the sac and the nose. Lacrimal and nasal mucosal flaps are created and an anastomosis is made between the lacrimal and nasal mucosal flaps by suturing them. The wound is then closed in layers.

II. Endoscopic DCR:

INDICATIONS : 1) Epiphora or infection in primary acquired nasolacrimal duct obstruction or nasolacrimal duct obstruction associated with specific inflammatory or infiltrative disorders. 2) Nasolacrimal duct obstruction associated with previous paranasal sinus surgery or trauma in selected patients. 3) Revision surgery following previous external or endonasal dacryocystorhinostomy. 4) Intrasaccal and postsaccal stenosis of nasolacrimal duct.

The nasal mucosa and lacrimal sac are approached via the nose using an endoscope for magnification and illumination. The mucosa is

incised and surgically excised or laser ablated. The rhinostomy is usually smaller than that of external DCR. There are no sutured flaps. Silicone tubes are usually used. Different types of endoscopic endonasal DCR are:

1. Endosurgical DCR [82]:

Surgical instruments like Freer's elevator, Blakesley forceps, curette, and rongeur are used. Alternatively powered tools, eg, micro drill or debrider can be used .

2. Endolaser DCR:

A laser is used to incise and ablate the mucosa and bone. The holmium: YAG or KTP laser are suitable, the latter having greater penetration for bone. The surgery can be entirely done by laser.

3. Endolaser Assisted Surgical DCR [83, 84]:

This includes the use of endoscopic surgical instruments to remove the charred tissue, augment the rhinostomy size and open the lacrimal mucosa (in addition to usage of laser).

Silicone Intubation in DCR:

The indication of intubation in DCR varies depending on surgeon's views and their choice. The main indications for temporary silicone intubation are:

1. External DCR when there is:
    a. Canalicular disease – e.g. distal common canalicular membranous occlusion or canalicular DCR.
    b. Inflammed sac mucosa, e.g. previous dacryocystitis.
    c. Poor flaps e.g. destroyed nasal or lacrimal sac flaps.
3. Endonasal DCR- (Since there are no sutured flaps).

MERITS OF EXTERNAL DCR:

1. The lacrimal sac is fully exposed; intra sac pathology can be identified. Membranectomy of common canalicular opening is possible.
2. The rhinostomy opening is relatively large.
3. Mucosal flaps are sutured and therefore silicone intubation is only used if indicated, as healing is rapid.

DEMERITS OF EXTERNAL DCR:

1. The cutaneous scar is visible
2. There is a risk of sump syndrome if the rhinostomy is placed too high in relation to the lacrimal sac. In the sump syndrome, the lacrimal system is patent to syringing but intermittent symptoms of epiphora and stickiness persist since the lacrimal sac cannot drain fully.

3. Resurgery may be complicated by excess fibrous tissue within the rhinostomy site and around the sac remnant, which has to be carefully dissected away.

MERITS OF ENDOSCOPIC ENDONASAL SURGICAL DCR:

1. Preservation of the lateral lacrimal sac wall and its attachments to the medial canthal tendon and orbicularis oculi muscle allows lacrimal pump to function more effectively.
2. Saving medial canthal tendon.
3. No skin incision, so avoidance of wound complications like scar, infection or bruising.
4. Limitation of tissue injury to osteotomy site, which makes resurgery easier.
5. There is no risk of sump syndrome, as the rhinostomy site is always adjacent to the lower part of the lacrimal sac.
6. Additional management of sinus, septal and conchal diseases.

DEMERITS OF ENDOSCOPIC ENDONASAL SURGICAL DCR:

1. There is a steep learning curve, with new anatomy and instruments.
2. The cost of the endoscopes and instruments are high.
3. Temporary silicone intubation is usually indicated for at least five weeks.

4. There are reported lower success rates, due to inadequate bone removal and with subsequent granuloma formation and sub mucosal fibrosis causing rhinostomy closure.

COMPLICATIONS OF DCR:

Intra Operative:

1. Haemorrhage.
2. Prolapse of orbital fat.
3. Injury to medial rectus muscle.
4. CSF leak.

Post Operative:

I. Early (4 weeks):

1. Wound infection, fistula or dehiscence (External).
2. Tube–Lateral displacement, Medial corneal erosion from tube at medial canthus.
3. Excessive rhinostomy crusting, intranasal synaechiae, delayed healing with secondary application of anti metabolites – Mitomycin–C.
4. CSF rhinorrhoea.

II. Intermediate (1- 3months):

1. Intra nasal synaechiae, rhinostomy fibrosis, granulomas at rhinostomy.

2. Tube – Lateral displacement, corneal erosion from tubes, and tube tie impaction at ostium.
3. Punctal- Cheese wiring, pyogenic granuloma.
4. Prominent facial scar, medial canthal tendon distortion (External).
5. Persistent fistula to skin from recurrent dacryocystitis in non functioning DCR.

III. Late Complication (6 months):

1. Persistent intra nasal synaechiae, rhinostomy fibrosis, delayed mucosal healing.
2. Webbed facial scar and MCT distortion (External).

AIMS AND OBJECTIVES

1. To compare the external dacryocystorhinostomy with endoscopic endonasal surgical dacryocystorhinostomy.
2. To evaluate the outcomes of the two procedure on subjective and anatomical basis.

MATERIALS AND METHODS

A prospective non randomised clinical interventional study was undertaken at Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Madurai; in the department of Orbit and Oculoplasty. The duration of the study was from May 2004 to June 2006. Fifty three patients with Primary nasolacrimal duct obstruction with chronic dacryocystitis were taken up for this study. Patients underwent either external or endoscopic endonasal surgical DCR depending on their preference after explaining the two procedures in detail. Consent of the patient was obtained before including in the study. The ethical committee in the hospital approved the study.

INCLUSION CRITERIA:

1. Patients with nasolacrimal duct obstruction.
2. Patent canaliculi.
3. Normal eyelid function.
4. No lacrimal sac pathology.

EXCLUSION CRITERIA:

1. Previous lacrimal surgery.
2. Functional nasolacrimal duct obstruction and canalicular obstruction.
3. Suspicion of malignancy.

4. Post traumatic bony deformity.

CLINICAL EVALUATION OF CASES:

1. **Patient Particulars:** Name, Age, Sex, Address, MR number.

2. **History:**

   a. RE / LE.

   b. H/o watering and discharge, associated pain, swelling over sac area, redness,

   c. H/o previous lacrimal surgery if any.

3. Ocular examination:

   a. Examination of lids – skin for scar, erythema and crusting, malposition of lids, lashes, functional assessment of lids like lid laxity and orbicularis function.

   b. Assessment of punctum – size (normal or stenosed), apposition of punctum.

   c. Examination of sac area – for redness, swelling, tenderness, fistula, regurgitation of contents on pressure.

   d. Silt lamp examination of the tear strip level and the anterior segment.

   e. Nasal examination for deviated nasal septum and polyps.

   f. Documentation of patency of lacrimal system by syringing.

4. General examination:

   a. Recording vital signs.

b. Pallor, icterus, cyanosis, and pedal edema were looked for.

c. Systemic examination.

d. Preanesthetic evaluation and anaesthetist opinion prior to general anaesthesia

e. Investigation – Haemoglobin, bleeding time, clotting time, blood grouping, and urine examination for sugar, albumin and microscopy. Random blood sugar measurement, chest X- ray and Electrocardiogram wherever indicated.

SURGICAL PROCEDURE:

Premedication :

No routine premedication was given to all patients. The cases, which were operated under general anaesthesia, were given a sedative with atropine parenterally as instructed by anaesthetist.

Preparation:

The eyelids and the periorbital area of the eye to be operated were painted with an iodine – based solution. The eye to be operated and the forehead were draped accordingly.

Anaesthesia:

General anaesthesia was used in all endonasal DCRs and in external DCR for patients < 14 years of age and if patient prefers. Other

patients were operated under local anaesthesia with 1 ml of 2% xylocaine with 1 in 2,00,000 adrenaline over the incision site (skin and subcutaneous tissue parallel and anterior to anterior lacrimal crest)

Techniques:

External DCR

Under local or general anaesthesia, nasal mucosa was packed with a pack soaked in lidocaine jelly and epinephrine mixture. Incision was made 10 mm medial to medial canthus in a straight line 2 mm above medial canthus extending for about 10 mm. Blunt soft dissection was made till the periosteum. Periosteum anterior to anterior lacrimal crest was incised with the sharp end of the periosteal elevator, reflected laterally to reveal the lacrimal sac fossa.

The thin lacrimal bone was fractured with the periosteal elevator allowing the introduction of the small kerrison‘s punch. Bony osteotomy was gradually enlarged until adequate size was obtained. Ostium size was measured using calipers. Lacrimal sac was tented with Bowman’s probe placed through the inferior canaliculus. No 11 blade was used to enter the sac over its tented position. With the help of Westcott scissors the entry over the sac was enlarged in vertical direction with relaxing incisions at the extremes of the wound to create a large anterior flap and a small posterior flap. The posterior flap was cut. No 11 blade was used to create corresponding flaps in the nasal

mucosa in a U pattern hinged anteriorly to permit closure of anterior flaps using 6-0 vicryl. Gentle wound irrigation was done through lower canaliculus. Skin was closed with 4 – 0 silk (interrupted sutures). Nasal packed was removed. Antibiotic eye ointment was applied over the wound and bandaged.

Endonasal Surgical DCR:

Under general anaesthesia, the nasal mucosa is decongested with a pack soaked in lidocaine jelly and epinephrine mixture. One ml of local anaesthetic mixed with adrenaline is injected at the proposed incision site in the nasal mucosa. Using a 30 degree Storz endoscope a mucosal flap hinged posteriorly, was elevated to expose the frontal process of maxilla and its articulation with the lacrimal bone. The incision was made 8 mm above the middle turbinate and is brought horizontally forward 8 mm anterior to middle turbinate. It was taken vertically down just above the insertion of the inferior turbinate before taking it posteriorly up to the insertion of uncinate process. After elevating the mucosal flap the lacrimal bone was peeled off from the inferior half of the lacrimal sac. Using a Blakesley forceps the frontal process of maxilla was removed until the bone becomes too thick for punch.

The sac was tented using a Bowman‘s probe to ensure adequate bone removal. The medial wall of the sac was incised vertically.

Lacrimal system was intubated using two ends of silicone tubing which were passed via superior and inferior puncta, pulled out through the ostium and tied and secured to lateral wall of the nose using 4-0 silk.

Post Operative Treatment and Follow-up:

Oral antibiotic and analgesic were prescribed for five days along with antibiotic eye ointment for the wound. Patients were discharged the next day and advised to review after ten days for first follow up. Suture removal was done in cases of external DCR during this visit. Further follow ups at three and six months were advised. Tube removal in case of endonasal DCR was done at three months follow up.

Follow up Schedule:

During follow up period, history regarding symptomatic relief of epiphora was recorded and examination was done to look for any complication like wound infection, gaping or scarring, suture tract formation, punctal eversion, prolapse of tube and cheese wiring of canaliculi. Syringing of the lacrimal system was done and results recorded. The results were graded [85]

1. **Full Success:**

   Patient's tearing in normal conditions had resolved, that no infection had recurred or no reflux through the opposite canaliculus on lacrimal irrigation.

2. **Partial Success:**

Patient's had less tearing than before and that irrigation partially or completely free through the ostium into the nose.

3. Surgical Failure:

The ostium had sealed and that patient had persistent or recurrent tearing.

OBSERVATIONS AND RESULTS

Table: 1

Distribution of Age Groups:

	Surgical Technique		Total
	External DCR	**Endonasal DCR**	
11 - 20	1 3.8%	2 7.4%	3 5.7%
21 – 30	4 15.4%	7 25.9%	11 20.8%
31 - 40	8 30.8%	11 40.7%	19 35.8%
41 – 50	8 30.8%	6 22.2%	14 26.4%
> 50	5 19.2%	1 3.7%	6 11.3%
Total	26 100.0%	27 100.0%	53 100.0%

In our study, age distribution of patients were such that maximum number (19 patients – 35.8%) of patients were in the age group of 31 – 40 years. The average age in external dacryocystorhinostomy group was 39 (range 13-55) and in endoscopic dacryocystorhinostomy group was 34 (range 19 – 53).

Table: 2

Gender Distribution of Cases:

	Surgical Technique		Total
	External DCR	Endonasal DCR	
Male	7 26.9%	9 33.3%	16 30.2%
Female	19 73.1%	18 66.7%	37 69.8%
Total	26 100.0%	27 100.0%	53 100.0%

Of the 53 patients included in the study, 16 patients (30.2%) were males and 37(69.8%) were females.

Table: 3

Laterality:

	Surgical Technique		Total
	External DCR	Endonasal DCR	
Right Eye	11 42.3%	9 33.3%	20 37.7%
Left Eye	15 57.7%	18 66.7%	33 62.3%
Total	26 100.0%	27 100.0%	53 100.0%

Among 53 patients included in our study, 20 (37.7%) had involvement of right eye while 33 (62.3%) had involvement of left eye.

Table: 4

Symptoms:

	Surgical Technique		Total
	External DCR	**Endonasal DCR**	
Watering, Discharge only	23 88.5%	26 96.3%	49 92.5%
Associated swelling over sac area	2 7.7%	1 3.7%	3 5.7%
Pain, Redness	1 3.8%		1 1.9%
Total	26 100.0%	27 100.0%	53 100.0%

All patients in the study group had symptoms of watering and discharge as their common complaint. Of them 49 patients (92.5%) had only symptoms of watering and discharge while 3(5.7%) had associated complaint of swelling over the sac area and one (1.9%) had associated pain and redness.

Table: 5

Pre Operative Syringing:

		Surgical Technique		Total
		External DCR	**Endonasal DCR**	
clear	Partially free with fluid		1 3.7%	1 1.9%
fluid	Not free with clear	6 23.1%	7 25.9%	13 24.5%
	Not free with mucous	8 30.8%	4 14.8%	12 22.6%
	Not free with pus	12 46.2%	15 55.6%	27 50.9%
Total		26 100.0%	27 100.0%	53 100.0%

Of the 53 patients who had epiphora, pre operative syringing showed partially free with clear fluid in one patient (1.9%), not free with clear fluid in 13 patients (24.5%), not free with mucous in 12 patients (22.6%) and not free with pus in 27 patients (50.9%).

Table: 6

Diagnosis:

	Surgical Technique		Total
	External DCR	Endonasal DCR	
PNL DO with CDC	23 88.5%	25 92.6%	48 90.6%
Encysted mucocele	3 11.5%	2 7.4%	5 9.4%
Total	26 100.0%	27 100.0%	53 100.0%

Among 26 patients in external dacryocystorhinostomy group 23 (88.5%) patients were diagnosed to have primary nasolacrimal duct obstruction and 3(11.5%) had encysted mucocele.

In endonasal dacryocystorhinostomy group 25 patients (92.6%) were diagnosed to have primary nasolacrimal duct obstruction and 2 (7.4%) had encysted mucocele.

Table: 7

Anesthesia:

	Surgical Technique	Total

	External DCR	**Endonasal DCR**	
Local	23 88.5%		23 43.4%
General	3 11.5%	27 100.0%	30 56.6%
Total	26 100.0%	27 100.0%	53 100.0%

All surgeries (27) in the endonasal dacryocystorhinostomy group were done under general anesthesia. In the external dacryocystorhinostomy group 23 surgeries (88.5%) were done under local anesthesia and 3(11.5%) were done under general anesthesia. Among these three patients, one was under the age group of 14 and the two who were adults preferred general anesthesia for surgery.

Table: 8

Intraoperative Complication:

		Surgical Technique		Total
		External DCR	**Endonasal DCR**	
Bleeding	Yes	1 3.8%	3 11.1%	4 7.5%
	No	25 96.2%	24 88.9%	49 92.5%
Total		26 100.0%	27 100.0%	53 100.0%

The only reported intraoperative complication in our study was slightly excessive bleeding which occurred in 4 (7.5%) out of 53 patients who underwent dacryocystorhinostomy. Of these one was in external and three were in endonasal dacryocystorhinostomy group. This was controlled by cautery and didn't require any further intervention.

Table: 9

Success:

	Surgical Technique		Total
	External DCR	**Endonasal DCR**	
Full Success	24 92.3%	20 74.1%	44 83%
Partial Success	2 7.7%	2 7.4%	4 7.5%
Failure		5 18.5	5 9.4%
Total	26 100.0%	27 100.0%	53 100.0%

In our study success was defined as full success, partial success and failure. In external dacryocystorhinostomy group, 92.3% (24 cases) had full success and 7.7% (2 cases) had partial success. There was no failure reported in this group.

In endonasal dacryocystorhinostomy group 74.1 % (20 cases) had full success, 7.4 % (2 cases) had partial success and 18.5% (5 cases) had failure. The five cases which had failure was advised repeat external DCR with intubation. Four patients underwent the same procedure and three had full success and one had partial success. One patient who had failure didn't come for follow up nor for re surgery.

Table: 10

Post operative complication:

	Surgical Technique		Total
	External DCR	**Endonasal DCR**	
None	22 84.6%	17 63.0%	39 73.6%
Prominent Scar	4 15.4%		4 7.5%
Pyogenic granuloma		1 3.7%	1 1.9%
Cheese wiring of canaliculi		2 7.4%	2 3.8%
Tube displacement		2 7.4%	2 3.8%
Failure – due to scarred ostium		4 14.8%	4 7.5%
Pyogenic granuloma + Failure		1 3.7%	1 1.9%
Total	26 100.0%	27 100.0%	53 100.0%

In external Dacryocystorhinostomy group the only complication seen in our study was prominent scar which was seen in 4 cases (15.4%).

In endonasal dacryocystorhinostomy group the complications seen in our study were pyogenic granuloma, cheese wiring of canaliculi, tube displacement, and failure. One patient (3.7%) had pyogenic granuloma, 2 (7.4%) had cheese wiring of canaliculi, 2 (7.4%) had tube displacement and 4 (14.8%) had faiure. One patient had both pyogenic granuloma and failure accounting for 3.7%.

DISCUSSION

Epiphora is an annoying symptom embarrassing the patient both socially and functionally. Lacrimal surgeries continue to evolve with new technical developments. There has been renewed interest in performing dacryocystorhinostomy through an intranasal approach using modern surgical tools such as endoscope and laser. The two widely accepted modalities of treatment for epiphora resulting from obstruction of the nasolacrimal ducts are external and endonasal dacryocystorhinostomy.

The current study was carried out for a period of two years on 53 cases who had nasolacrimal duct obstruction of which 26 cases underwent external DCR and 27 cases underwent endonasal DCR. Both the groups were operated by single surgeon. The purpose of the study is to compare the success rates and complications of these two procedures.

In our study we have defined success as full success, partial success and failure based on symptomatic relief of epiphora and patency of nasolacrimal duct post operatively. In external dacryocystorhinostomy group, 92.3% (24 cases) had full success and 7.7% (2 cases) had partial success. There was no failure reported in this group. In endonasal dacryocystorhinostomy group, 74.1 % (20 cases)

had full success, 7.4 % (2 cases) had partial success and 18.5% (5 cases) had failure. The difference in overall success rate (p value - 0.06) was not statistically significant. The success rate in our study was comparable to that of Hartikainen et al[86] 's who reported a success of 95% in external dacryocystorhinostomy and 71 % in endonasal dacryocystorhinostomy.

Although the endonasal approach to perform dacryocystorhinostomy has been described since late 1800s, interest in this technique was renewed only in 1900, by Massaro et al, who introduced the concept of using a transillumination target within the lacrimal sac to guide placement of the osteotomy. Since then numerous case series have reported various modifications of the technique.

In our study videoendoscope assisted endonasal dacryocystorhinostomy, improved the visualization of the surgical site. A pack soaked in lidocaine and epinephrine mixture was used to pack the nasal mucosa to ensure a good hemostasis. Care was taken not to traumatize the nasal mucosa either by suction or the instruments, to minimize the bleeding and reduce the risk of bridging scar between the ostium site and middle turbinate or septum. The osteotomy created using a Blakesley forceps was made large and particular attention was given in removing the bone superiorly where inadequate bone removal was noted to be a common cause of surgical failure. We used

mechanical stent like silicone tubes to keep the raw mucosal edges close together for more rapid primary intention healing and to prevent the secondary intention granulation and closure of the ostium. All the above techniques helped us to improve the surgical outcome in endonasal group.

The failure in the endonasal dacryocystorhinostomy group could be explained by the fact that there are profound individual anatomic variations in nasal and sinus anatomy, preventing the placement of adequate bony and soft tissue ostium. Some authors have recommended creating a small ostium involving primarily the inferior portion of the thin lacrimal bone while others advocated developing a large ostium and removing the thicker frontal process of the maxilla. But available data do not support the clear superiority of a particular option in terms of ostium size and location.

The silicone tube, although inert material may cause peripunctal granulation and chronic infection due to the granuloma inducing impurities which may compromise long term ostium patency. This could also explain the failure in endonasal dacryocystorhinostomy group. In our endonasal group two patients had pyogenic granuloma, which was excised. Of these, one patient did well but the other had recurrent granuloma which was again excised along with removal of the tube which later on ended in repeat external

dacryocystorhinostomy for surgical failure. The placement of silicone tubes necessitates long follow up until it is removed and patient should be explained and convinced about epiphora which will persist until the tube is removed.

Although the adjunctive use of the antimetabolite mitomycin C[87] has been advocated to reduce wound healing and possibly prevent scarring of the ostium, none of the patients in this study was treated with mitomycin C. The use of lasers in endonasal dacryocystorhinostomy require safety precautions and they generate char around the ostium site requiring postoperative wound cleaning and potentially accounting for the poorer success rates reported for laser endonasal dacryocystorhinostomy.

The high success rate in external dacryocystorhinostomy can be explained by the fact that it establishes an immediate mucosal lined fistula between the lacrimal sac and nose via the closure of mucosal flaps.

In external Dacryocystorhinostomy group the only complication seen in our study was prominent scar which was seen in 4 cases (15.4%). In endonasal dacryocystorhinostomy group the complications seen in our study were pyogenic granuloma, cheese wiring of canaliculi, tube displacement, and failure. One patient (3.7%) had pyogenic granuloma, 2 (7.4%) had cheese wiring of canaliculi, 2 (7.4%) had tube

displacement and 4 (14.8%) had failure. One patient had both pyogenic granuloma and failure accounting for 3.7%.

COMPARATIVE STUDIES

AUTHOR	STUDY	SUCCESS		COMPLICATIONS
		EXT	ENDO	
1.Peter .J.D et al 1999	External Vs Endonasal DCR	92.2%	93.1%	External DCR- Epistaxis-7, Bruising-4, Infection of wound - 2,Punctal eversion -6. Endonasal DCR- Epistaxis-9, Injury to periorbita-5, Transient diplopia- 1.
2.Angelo Tsirbas et al 2000	External Vs Mechanical endonasal DCR	93.8%	93.5%	External DCR- Scar -1 Endonasal DCR- Post operative hemorrhage
3. Ben Simon et al 2004	External Vs endonasal DCR	70%	84%	Endonasal DCR -Epistaxis (1) Sump syndrome(2)
4.Hartikainen et al 1999	External Vs laser assisted endonasal DCR	91%	63%	External DCR- Scar (1), Tube displacement (1),Laceration of puncta (4) Endonasal laser DCR-Tube displacement (1),Laceration of punctum (7)
5. Our study 2006	External Vs endonasal surgical DCR.	**100%**	**81.5%**	External DCR- Scar(4) Endonasal DCR- Pyogenic granuloma (2) Cheese wiring of canaliculi(2) Tube displacement(2) ,Failure(5)

CONCLUSION

In our study,

1. The age distribution of patients were such that maximum number (35.8%) of patients were in the age group of 31 – 40 years.
2. Females constituted 69.8% while males constituted only 30.2%.
3. 62.3% of cases presented with nasolacrimal obstruction on left side
4. External dacryocystorhinostomy had higher success rate of 100% while endonasal surgical DCR had a success rate of 81.5%, but the difference is statistically insignificant.
5. In external Dacryocystorhinostomy the only complication seen in our study was prominent scar (15.4%). In endonasal dacryocystorhinostomy the complications seen in our study were pyogenic granuloma (3.7%), cheese wiring of canaliculi (7.4%), tube displacement (7.4%), and failure (14.8%). One patient had both pyogenic granuloma and failure accounting for 3.7%.
6. External dacryocystorhinostomy is a standard surgical procedure for the treatment of nasolacrimal duct obstruction for successful outcome with minimal risk of disturbing scar. It allows for the inspection of the lacrimal sac for pathology like tumors and dacryoliths and easy suturing of the mucosal flaps.
7. Endonasal dacryocystorhinostomy may be a viable option for the treatment of nasolacrimal duct obstruction. Disadvantage of this

procedure include the preferred use of general anesthesia by many surgeons, the need for expensive equipment and instrumentation, and the relatively steep learning curve for this procedure. Both the advantages and disadvantages of endonasal DCR relative to external DCR should be carefully discussed with patients contemplating endonasal surgery.

8. Future studies comparing DCR techniques should measure the size of the created soft tissue and bony ostium, and the end point should include not only improvement in symptoms but more importantly static and dynamic observation and analysis of the healed ostium.

BIBLIOGRAPHY

1. Mc donongh M, Mering JH. - Endoscopic transnasal dacryocystorhinostomy. *J Laryngol Otol 1989 ; 103: 585-7.*

2. Whittet HB, Shun- Shin AG, Awdry P. Functional endoscopic transnasal dacryocystorhinostomy .*Eye 1993; 7: 545-9.*

3. Muellner K, Bodner E, Mannor GE, et al. Endolacrimal laser assisted lacrimal surgery. *Br J Ophthalmol 2000; 84: 16-8.*

4. Peralman SJ, Michalos P, Reib ML, et al. Translacrimal transnasal laser assisted dacryocystorhinostomy.*Laryngoscope 1997; 107: 1362-5.*

5. Woog JJ, Kennedy RH , Custer PL , et al. Endonasal dacryocystorhinostomy: *a report by the American Academy of Ophthalmology 2001; 108:2369-77.*

6. Ibrahim HA, Batterbury M, Banhegyi G, et al. Endonasal laser dacryocystorhinostomy and external dacryocystorhinostomy outcome profile in a general ophthalmic service unit: a comparative retrospective study. *Ophthal Surg Lasers 2001; 32:220-7.*

7. Tarbet KJ, Custer PL. External DCR. *Ophthalmology 1995; 102: 1065-70*.

8. Cokkeser Y, Evereklioglu C, Hamdi E. Comparative external versus endoscopic dacryocystorhinostomy: results in 115 patients (130 eyes). *Otolaryngol Head Neck Surg 200; 123: 488-91*

9. Bailey, J.H. Surgical anatomy of the lacrimal sac. *Am. J. Ophthalmol.,1923; 6, 665-71.*

10. *Wolff's anatomy of the Eye and Orbit* – Eighth edition – Anthony J. Bron, Ramesh C. Tripathi and Brenda J. Tripathi.

11. *Clinical anatomy of the eye* – Second edition - Richard S. Snell, Michael A. Lemp.

12. Calhoun, K.H., Rotzer, W.H. and Stiernberg, C.M. Surgical anatomy of the lateral nasal wall. *Otolaryngol. Head Neck Surg., 1990; 1032*

13. *Adler's physiology of the eye* – Lacrimal apparatus- ninth edition – William. M. Hart.

14. Mathur, SP. Study of lacrimal pump mechanism and management of epiphora,*Ophthalmic news and views. Vol (5) (4) 1986 oct 135-138.*

15. Bruce B. Becker. Tricompartmental model of the lacrimal pump mechanism. *Ophtahlmology 1992; 99: 1139-1145.*

16. Doane MG.Blinking and the mechanics of the lacrimal drainage system, *Ophthalmol 1981; 88: 844.*

17. David M. Reifler, Early description of horner's muscle and the lacrimal pump.*Survey of Ophthalmology. Vol 41(2) -1996 127-134.*

18. Hirohiko Kakizaki, Masahiro Zako, Osanu Miyaishi, Takashi Nakano, Ken Asamoto, Masayoshi Iwaki- The lacrimal canaliculus and sac bordered by the horner's muscle form the

functional lacrimal drainage system. *Ophthalmology 2005; 112:710-716*

19. Hill JC, Bethell W, Smirinaul HJ. Lacrimal drainage- a dynamic evaluation, I, Mechanics of tear transport - *Can J Ophthal 9: 411, 1974.*

20. Hill JC, Bethell W, Smirinaul HJ. Lacrimal drainage- a dynamic evaluation, II, Clinical aspects - *Can J Ophthal 9: 417, 1974.*

21. David M Maurice. The dynamic drainage of tears - *International ophthalmology clinics, 1973; 13: 103-116.*

22. Jones Lester T - Epiphora: Its causes and new surgical procedures for its cure. *Am J Ophthalmol, Vol: 38 (6); 1954; Dec. p.824.*

23. Cherubini, Thomas D - Epiphora and related disorders of the lacrimal system - Int Ophthalmol Clin: Ophthalmic Plastic Surgery. *Vol: 10 (1) ; 1970;Spring p.23.*

24. Jones Lester T; Linn M L - The diagnosis of the causes of epiphora. *Am. J. Ophthalmol, Vol: 67 (5); 1969; May p.751.*

25. Werb. A - Current Ophthalmology: Unusual auses of epiphora – *Surv Ophthalmol, Vol: 18 (3); 1973; Nov. p.241-242.*

26. Jones Lester T – Epiphora - *Am J Ophthalmol,Vol: 43 (2); 1957 ; Feb. p.203*

27. Glatt, Herbert J- Epiphora caused by blepharoptosis - *Am. J. Ophthalmol, Vol: 111 (5); 1991; May p.649-650.*

28. Georgiadiss, Nick S; Terzidou, Chrryssa D- Epiphora caused by conjunctivochalasis : Treatment with transplantation of preserved human amniotic membrane- *Cornea, Vol: 20 (6); 2001; Aug p.619-621.*

29. Putterman, Allen M- Treatment of epiphora with absent lacrimal puncta. *Arch Ophthal, Vol: 89 (2); 1973; Feb. p.125.*

30. Kashkouli, Mohsen Bahmani et al- Acquired external punctal stenosis: etiology and associated findings- *Am. J. Ophthalmol-Vol: 136 (6); 2003; Dec, p.1079-1084.*

31. Cahill, Kenneth V; Burns, John A- Management of epiphora in the presence of congenital punctal and canalicular atresia- *Ophthalmic Plas Reconstructive Surgery- Vol: 7 (3); 1991; Sep.p.167-172.*

32. Veirs Everett R- Stenosis of the canaliculus following irradiation therapy -Management of epiphora- *Am. J. Ophthalmol-Vol: 44 (2); 1957; Aug.p.249.*

33. Call, N Branson; Welham, Richard A N- Epiphora after irradiation of medial eyelid tumors-*Am. J. Ophtahlmol- Vol: 92 (6); 1981; Dec. p.842.*

34. Lee, Vickie; Bentley,Christopher R and Olver, Jane M- Sclerosing canaliculitis after 5-Fluorouracil breast cancer chemotherapy- *Eye-Vol: 12 (3A); 1998 ; Jun.p.343-349.*

35. Anderson, D R- Unilateral epiphora caused by a papilloma of the lower canaliculus - *Arch Ophthal-Vol: 78 (5); 1967; Nov p.618.*

36. Putterman, Allen M- Eyelid epiphora secondary to lacrimal gland fistula- *Ophthalmic Surg-Vol: 11 (10); 1980; Oct. p.68.*

37. Miller Calvin L et al- Adenoid cystic carcinoma of the antrum and epiphora- *Am. J. Ophthalmol- Vol: 83 (4); 1977; Apr.p.582.*

38. Maini, R; MacEwen, C J- The natural history of epiphora in childhood *Eye- Vol: 12 (4); 1998; Aug.p.669-671.*

39. Cies William A; Baylis Henry I-Epiphora following rhinoplasty and caldwell-luc procedures-*Ophtahlmic Surg- Vol: 7 (1); 1976; spring p.77.*

40. Flanagan Joseph C- Epiphora following rhinoplasty- *Ann Ophthalmol. Vol: 10 (9); 1978; Sep. p.1239.*

41. Sekar, G Chandra-Practical approach to a patient with epiphora- *Indian J Ophthalmol-Vol: 42 (3); 1994 Sep.p.157.*

42. Nagappan, N- Investigation and management of epiphora- *TNOA- Vol: 30 (3); 1992; Sep, p.49-51.*

43. Guzek, James P et al.- Clinical and radiologic lacrimal testing in patients with Epiphora-*Ophthalmology-Vol: 104 (11); 1997; Nov, p.1875-1881.*

44. Cuthbertson, F M; Webber, S- Assessment of functional nasolacrimal duct obstruction – A Survey of Ophthalmologists in the Southwest-*Eye- Vol: 18 (1) ; 2004; Jan,p.20-23.*

45. Conway, S. T - Evaluation and management of functional nasolacrimal blockage: results of a survey of the American Society of Ophthalmic Plastic and Reconstructive Surgery-*Ophthal Plastic Reconstructive Surg- 1994; 10; 185-7.*

46. Welham, R. A. N., Investigations for patients undergoing lacrimal surgery - *Eye, 1998; 12; 334-6.*

47. Hurwitz, J.J., - Investigation and treatment of epiphora due to lid laxity - *Trans Ophthal. Soc UK – 1978; 98,69-70.*

48. Burkat, Cat N; Lucarelli, Mark J- Tear meniscus level as an indicator of nasolacrimal obstruction-*Ophthalmology-Vol: 112 (2); 2005; Feb. p 344-348.*

49. Flack, A - The fluorescein appearance test for lacrimal obstruction -*Annals Ophthalmol-1979; 11; 237.*

50. MacEwen, C.J. and Young, J.D.H - The fluorescein disappearance test (FDT): an evalution of its use in infants. – *J. Paed. Ophthal.Strab-1991; 28; 302-5.*

51. Tucker, N. A and Codere , F – The effect of fluorescein volume on lacrimal outflow transit time – *Ophthal Plastic Reconstructive Surg- 1994; 10; 256-9*

52. Zappia, R.J. and Miller, B – Lacrimal drainage function. II. The fluorescein dye disappearance test – *Am. J. Ophthal 1972 b; 74; 160-2.*

53. Zappia, R.J and Miller, B. Lacrimal drainage function. I. The Jones fluorescein test – *Am J Ophthal 1972 a; 74; 154-9*

54. Homblas A: A simple taste test for lacrimal obstruction - *Arch Ophthal 1973; 90: 435-6.*

55. Enzer, Yoash R; Shorr, Norman- The Jones IE Test: cobalt blue endoscopic primary dye test for lacrimal excretory function- *Ophthalmic Plas Reconstructive Surgery-Vol: 13 (3); 1997; Sep. p 204-209.*

56. Guinot-Saera, Ana; Koay, Peter- Efficacy of probing as treatment of epiphora in adults with blocked nasolacrimal ducts-*Br J Ophthalmol- Vol: 82 (4); 1998 ;Apr. p.389-391.*

57. Irfan, S; Cassels-Brown, A and Nelson, M- Comparison between nasolacrimal syringing / probing, macrodacryocystography and surgical findings in the management of epiphora- *Eye - Vol: 12 (2); 1998; Apr.p.197-202.*

58. Robb, Richard M- Probing and irrigation for congenital nasolacrimal duct obstruuction- *Arch of Ophthal- Vol 104 (3); 1986: Mar .p 378.*

59. Olver, J.M and Minisian, M- Nasal endoscopy for ophthalmologist – *CME J. Ophthalmaol., 1998 2;73 -7.*

60. Hurwitz, Jeff J; Warren H Victor- The role of sophisticated radiological testing in the assessment and management of epiphora -*Ophthalmology-Vol: 92 (3); 1985; Mar.p.470*.

61. Wobig, John L; Wirta, David L- Clinical and radiologic lacrimal testing in patients with epiphora - *Ophthalmology-Vol: 105 (9); 1998; Sep.p.1574.*

62. Wearne, M.J., Frank, J and Rose, G.E - Comparison of dacryocystography and lacrimal scintigraphy in the diagnosis of functional nasolacrimal duct obstruction – *Br J Ophthalmol-1999; 83: 1032-5.*

63. Mehrotra A S; Sabahrwal K K- Distention dacryocystography and its results in normal and epiphora cases - *Indian J Ophthalmol-Vol: 32, 1984; Sep.p.364*.

64. Galloway, J. E., Kavic, T.A and Raflo, G.T-Digital subtraction macrodacryocystography – *Ophthalmology, 1984; 91: 956-62.*

65. Jedrzynski, M.S. and Bullock, J.D. – Radionuclide DCG – *Orbit-1998; 17: 1-25.*

66. Lloyd, G. A. G and Welham, R.A.N – Subtraction DCG - *Br. J. Radiolo- 1972; 47 : 379-82.*

67. Llyod,G.A.S.,Jones,B.R and Welham,R.A.N–Intubation DCG, - *Br. J Ophthalmol 1972; 56: 600-3.*

68. Amanat, L A- Lacrimal scintigraphy- Its role in the diagnosis of epiphora - *Br J Ophthalmol-Vol: 67 (11); 1983; Nov, p.720-28.*

69. Hanna, I. T., MacEwen, C. J. and Kennedy, N. - Lacrimal scintigraphy in the diagnosis of epiphora- *Nuclear Med. Comm., 1992, 13, 416-20.*

70. Hurwitz , J.J., Miisey, M.N. and Welham, R.A.N- Quantitaive lacrimal scintigraphy- *Br J Ophthalmol- 1975; 59: 308-12.*

71. Dortzbach- DCR- *Ophthalmology- 1978; 85: 1267-70.*

72. Caldwell G.W – Two new operation for the obstruction of the nasal duct with the preservation of the canaliculi. *Am J Ophthalmol 1893; 10: 189.*

73. West J- A window resection of the nasal duct in cases of stenosis - *Trans Am Ophthalmol Soc- 1995; 12: 659.*

74. Massaro BM, Gonnering RS, Harris GJ- Endonasal laser DCR- A new surgical approach to nasolacrimal duct obstruction - *Arch Ophthalmol- 1990; 108: 1172-6.*

75. Gonnering RS, Lyon DB, Fischer JC- Endoscopic laser assisted lacrimal surgery – *Am J Ophthalmol- 1991; 111: 152-7.*

76. Wogg JJ, Metson R, Puliafito CA- Holmium- YAG endonasal laser DCR- *Am J Ophthalmol- 1993; 116: 1-10.*

77. Levin PS, Stormo Gipson DJ- Endocanalicular laser assisted DCR- an anatomic atudy – *Arch Ophthalmol- 1992; 110:1488-90.*

78. Warren, John F; Seiff, Stuart R and Kavanagh, Marsha C- Long-term results of external dacryocystorhinostomy - *Ophthalmic Surg Lasers Imaging-Vol: 36 (6); 2005; Nov.-Dec,p.446-450.*

79. Rambhatla, Saptagirish- External dacryocystorhinostomy- *TNOA- Vol: 43C (2); 2005; Jun,p.57-61.*

80. Delaney, Y M; Khooshabeh, R- External dacryocystorhinostomy for the treatment of acquired partial nasolacrimal obstruction in adults- *Br J Ophthalmol- Vol: 86 (5); 2002; May,p.533-535.*

81. Shun-Shin, G Adrien; Thurairajan, Geetha-External DCR - An end of an era - *Br J Ophthalmol- Vol: 81 (9); 1997; Sep, p.716-717.*

82. Tsirbas, Angelo; Wormald, Peter J- Endonasal DCR with mucosal flaps - *Am. J. Ophthalmol- Vol: 135 (1); 2003; Jan, p.76-83.*

83. Sadiq, S A et al-Endonasal Laser Dacryocystorhinostomy - medium term results - *Br J Ophthalmol- Vol: 81 (12); 1997; Dec, p.1089-1092.*

84. Von Arx, Georg - Endonasal laser dacryocystorhinostomy- *Br J Ophthalmol- Vol: 82 (8); 1998; Aug, p.976.*

85. Peter J Dolman - Comparison of external dacryocystorhinostomy with nonlaser endonasal dacryocystorhinostomy - *Ophthalmology 2003; 110:78- 84.*

86. Hartikainen J, Jukka A, Matti V, et al - Prospective ramdomised comparision of endonasal endoscopic dacryocystorhinostomy and external DCR - *Laryngoscope 1998; 108: 1861- 66.*

87. Liao SL, Kao SCS, Tseng JHS et al. Results of intraoperative mitomycin C application in DCR - *Br J Ophthal 2000; 84 : 903-6*

COMPARISON OF EXTERNAL DACRYOCYSTORHINOSTOMY WITH ENDOSCOPIC SURGICAL DACRYOCYSTORHINOSTOMY

PROFORMA

Name : M.R. No. :

Age : Sex : Male - 1
Female - 2

History

a) Eye : Right –1; Left – 2

b) Symptoms : Watering, Discharge only – 1
Associated swelling over sac area - 2
Pain, Redness – 3.

Ocular Examination

a) Lids : Skin – Scar, Erythema, Crusting if any
Malposition
Lashes
Functional assessment –
Lid laxity, orbicularis function

b) Lacrimal punctum : Size – Normal, stenosed.
Apposition

c) Regurgitation on pressure : Clear fluid, mucous, purulent fluid

d) Conjunctiva

e) Nasal Examination : Deviated nasal septum, polyps if any

Preop Syringing

1. Partially free with
2. Not free with
   a. Clear fluid through opposite punctum
   b. Mucous
   c. Pus

Diagnosis

1. Primary nasolacrimal duct obstruction with CDC.
2. Congenital nasolacrimal duct obstruction .
3. Encysted mucocele.

Surgery Undergone

- External / Endonasal Dacryocystorhinostomy .
- Surgeon :
- Date of surgery :
- Anesthesia : Local – 1
  General – 2

Intra Operative Complication

- Bleeding : Yes – 1
  No – 2

Postoperative Follow up

- Symptoms if any :
- Date of suture removal \ tube removal :
- Complications :
  1. None
  2. Wound infection
  3. Prominent scar
  4. Pyogenic granuloma
  5. Cheese wiring of canaliculi
  6. Punctal eversion
  7. Suture tract formation
  8. Tube displacement
  9. Failure – due to scarred ostium
  10. Pyogenic granuloma + Failure (4,9)

Success

1. Full success
2. Partial success
3. Failure

ABBREVIATIONS

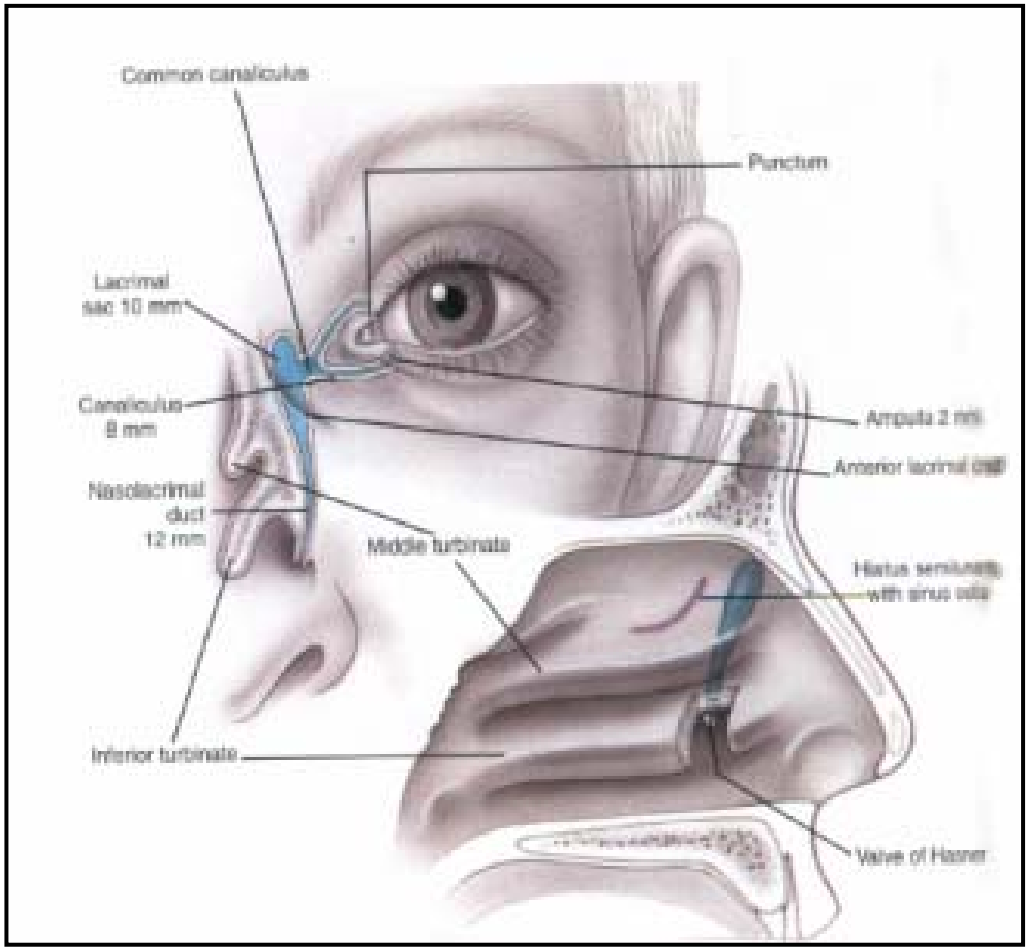
1.	CDC	:	Chronic dacryocystitis
2.	CT	:	Computerized tomogram
3.	DCG	:	Dacryocystography
4.	DCR	:	Dacryocystorhinostomy
5.	5 – FU	:	5 – Flurouracil
6.	EEL-DCR	:	Endoscopic endonasal laser dacryocystorhinostomy
7.	EES-DCR	:	Endoscopic endonasal surgical dacryocystorhinostomy
8.	EN-DCR	:	Endonasal dacryocystorhinostomy
9.	EX-DCR	:	External dacryocystorhinostomy
10.	FDDT	:	Fluorescein dye disappearance test
11.	GA	:	General anesthesia
12.	HSV	:	Herpes simplex virus
13.	LA	:	Local anesthesia
14.	MCT	:	Medial canthal tendon
15.	MENDCR	:	Mechanical endonasal dacryocystorhinostomy
16.	MPL	:	Medial palpebral ligament
17.	MRI	:	Magnetic resonance imaging
18.	NLD	:	Nasolacrimal duct
19.	NLDO	:	Nasolacrimal duct obstruction
20.	USG	:	Ultrasonogram
21.	VZ	:	Varicella zoster

EXTERNAL DCR

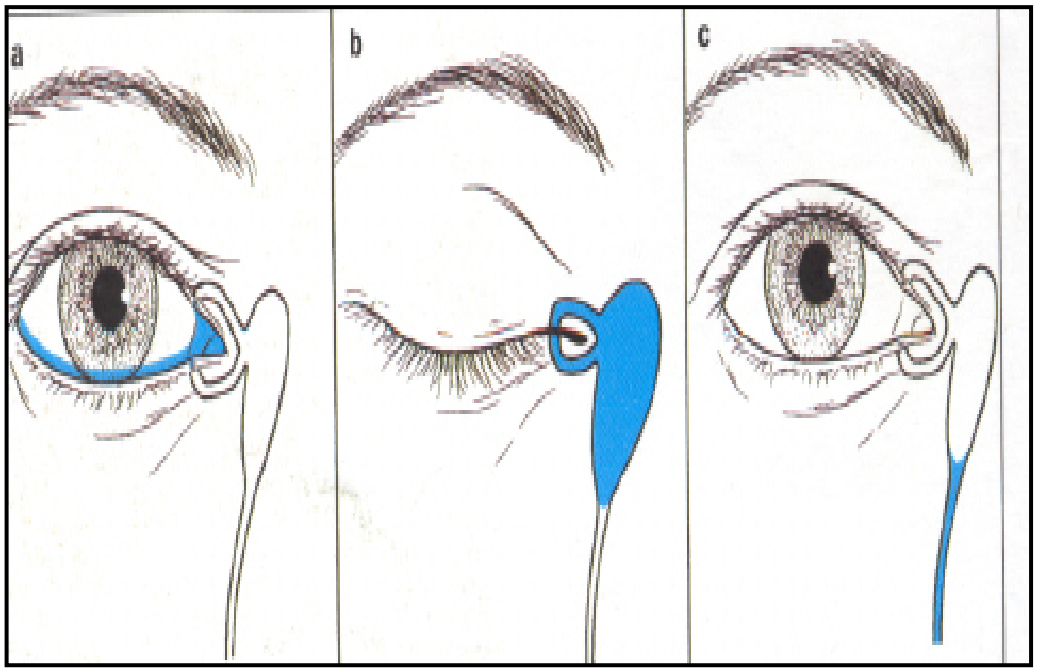
S. No	Name	Mr No	Age	Sex	Eye	Symptom	Preop syringing	Diag	Anaes	Intra opcomp	Success	Postop comp
1.	Balgees beevi	2020604	29	2	2	1	2c	1	1	2	1	1
2.	Syed	2022259	26	1	1	1	2b	1	1	2	1	1
3.	Mani	2080531	45	1	1	1	2c	1	1	1	1	1
4.	Poomayil	2062624	45	2	2	1	2a	1	1	2	1	1
5.	Parisal Beevi	2094491	54	2	1	1	2b	1	1	2	1	1
6.	Dhanalakshmi	2097450	45	2	1	1	2b	1	1	2	1	1
7.	Ammapillai	2095724	34	2	2	1	2b	1	1	2	1	1
8.	Mallika	2084393	35	2	2	1	2b	1	1	2	1	1
9.	Rajasekar	2140609	45	1	2	1	2c	1	1	2	1	1
10.	Murugesan	2128928	39	1	1	1	2c	1	1	2	1	1
11.	Marutupandi	557398	33	1	2	1	2a	3	1	2	1	1
12.	Bakiam	558951	45	2	1	1	2c	1	2	2	1	1
13.	Kalaiselvi	1885849	13	2	2	3	2c	1	2	2	2	3
14.	Kanaga	2091869	33	2	2	2	2a	3	1	2	1	3
15.	Danalakshmi	1851173	30	2	2	1	2c	1	1	2	1	1
16.	Rasamal	2001718	45	2	1	1	2c	1	1	2	1	1
17.	Vetriselvi	2024661	27	2	2	1	2b	1	1	2	1	1
18.	Saroja	2033906	53	2	2	1	2c	1	1	2	1	1
19.	Citradevi	2036318	31	2	1	1	2a	1	2	2	2	3
20.	Sembulingam	2056503	48	1	2	1	2b	1	1	2	1	1
21.	Amuta	2090877	36	2	1	2	2c	3	1	2	1	1
22.	Kamalam	2102210	55	2	2	1	2c	1	1	2	1	1
23.	Marathal	2093714	50	2	1	1	2a	1	1	2	1	1
24.	Saraswathi	2124578	48	2	1	1	2a	1	1	2	1	1
25.	Rajeswari	1864841	55	2	1	1	2c	1	1	2	1	1
26.	Venkatapathy	2097998	34	1	2	1	2b	1	1	2	1	1

ENDONASAL DCR

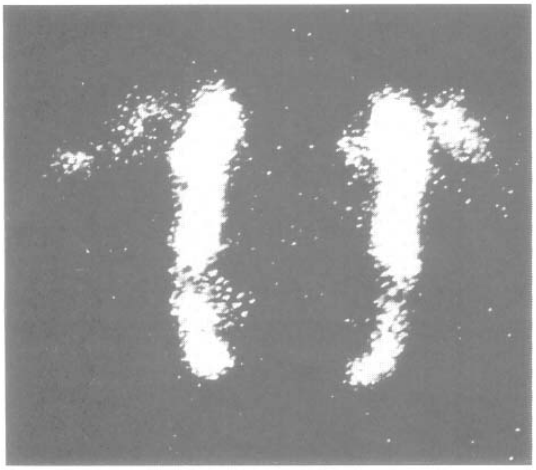
S. No	Name	Mr No	Age	Sex	Eye	Symptom	Preop syringing	Diag	Anaes	Intra opcomp	Success	Postop comp
1.	Hathijammal	1878484	22	2	2	1	2b	3	2	2	1	1
2.	Sasikala	1757766	39	2	2	1	2a	1	2	2	1	1
3.	Fatimahusain	1889836	42	2	1	1	2b	1	2	2	1	1
4.	Srinivasan	1890421	31	1	2	1	2c	1	2	2	1	1
5.	Meenakshi	1892814	50	2	2	1	2c	1	2	2	3	9
6.	Janakiram	1897084	25	2	2	1	2c	1	2	2	1	1
7.	Kumar	1894515	19	1	1	2	2b	3	2	2	1	1
8.	Kaleeswari	1886081	19	2	2	1	2c	1	2	2	1	1
9.	Periyasami	1904989	43	1	2	1	2c	1	2	2	1	8
10.	Lakshmi	1939122	35	2	1	1	2a	1	2	2	2	5
11.	Sureshkumar	1942744	34	1	2	1	2c	1	2	2	3	4, 9
12.	Mahalakshmi	1950885	26	2	2	1	2c	1	2	2	3	9
13.	Rajeswari	1942861	43	2	2	1	2c	1	2	2	1	1
14.	Mercilin	1957844	46	2	1	1	1a	1	2	2	3	9
15.	Murugan	1950206	40	1	1	1	2c	1	2	1	1	2
16.	Usha	2027203	21	2	2	1	2c	1	2	2	1	2
17.	Laila	2068083	39	2	2	1	2a	1	2	2	3	1
18.	Rokayabeevi	561213	53	2	2	1	2a	1	2	2	1	2
19.	Ganesan	2009828	32	1	1	1	2b	1	2	2	1	2
20.	Duraiselvam	561328	32	1	2	1	2a	1	2	2	1	2
21.	Shanmugavalli	562070	27	2	2	1	2a	1	2	2	1	2
22.	Radha	562159	35	1	2	1	2c	1	2	2	1	2
23.	Mariammal	562420	50	2	2	1	2c	1	2	2	1	2
24.	Abdul	2172373	34	1	1	1	2a	1	2	2	1	2
25.	Pandeswari	567270	30	2	2	1	2a	1	2	1	1	2
26.	Amutha	567286	21	2	1	1	2c	1	2	1	2	2
27.	Kaliammal	562061	35	2	1	1	2c	1	2	2	1	2



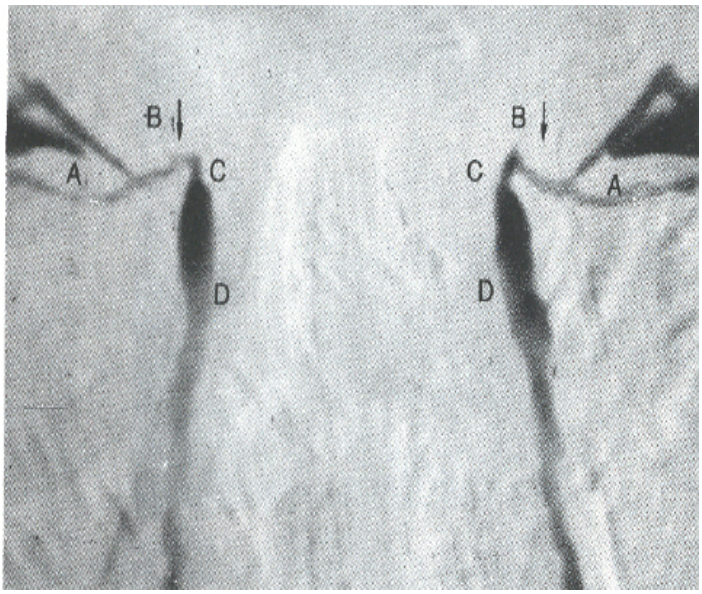
ANATOMY OF LACRIMAL PASSAGE



PHYSIOLOGY OF LACRIMAL PUMP

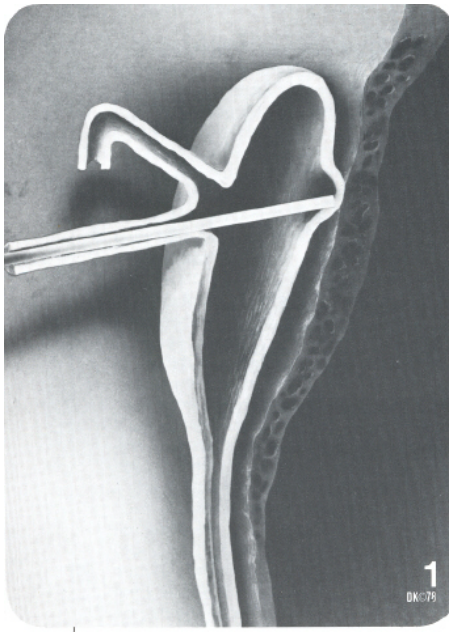


NUCLEAR LACRIMAL SCINTIGRAPHY

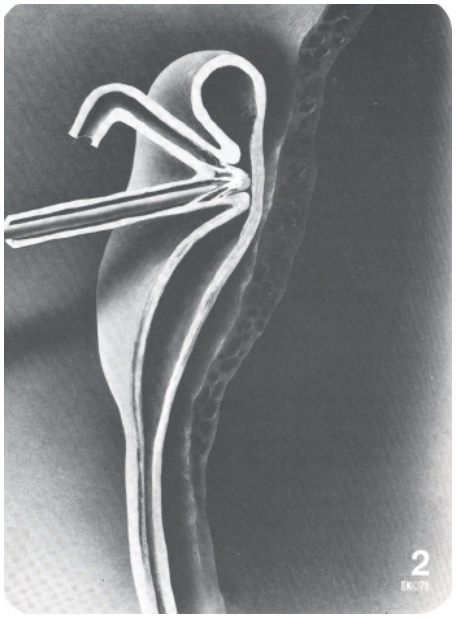


DIGITAL SUBTRACTION DCG

PROBING

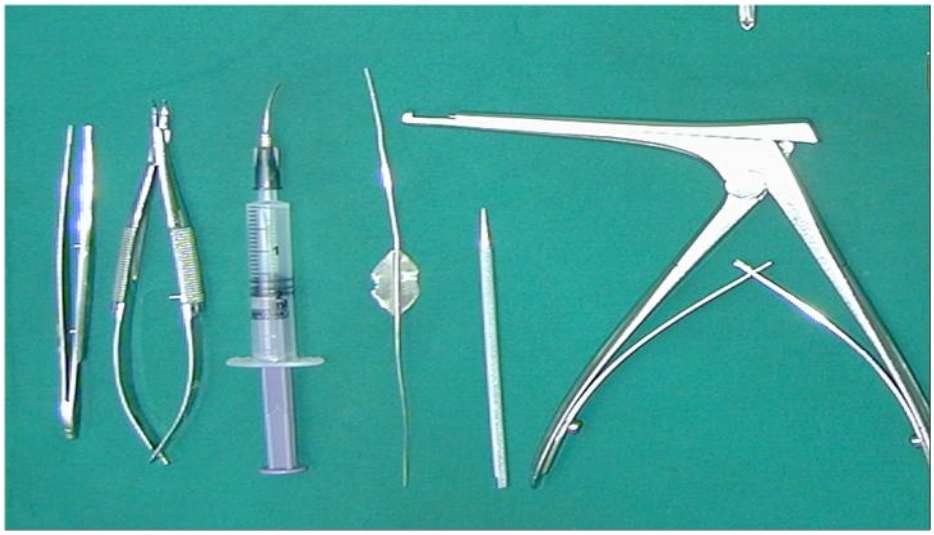


HARD STOP



SOFT STOP

INSTRUMENTS USED IN EXTERNAL DCR



INSTRUMENTS USED IN ENDONASAL DCR

(a)

(b)

(c)

(d)

a. Endonasal surgical DCR instruments with 30° Storz endoscope

b. Silicone intubation set with retriever

c. Tips of Blakesley forceps : Thru – cut, straight, up biting (from left to right)

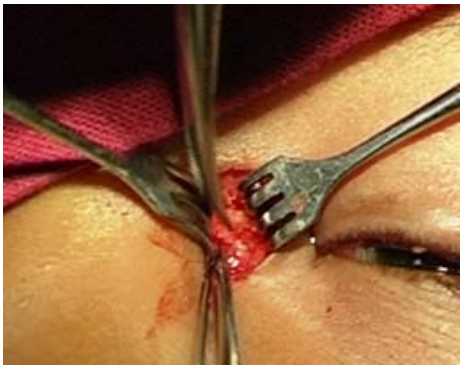
d. Light source

SURGICAL STEPS IN EXTERNAL DCR

(a)

(b)

(c)



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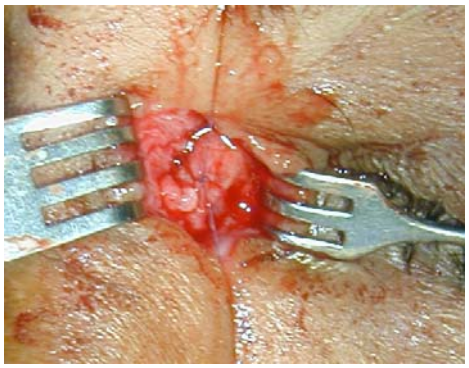


(e)

(f)

a. Skin incision

b. Dissecting periosteum

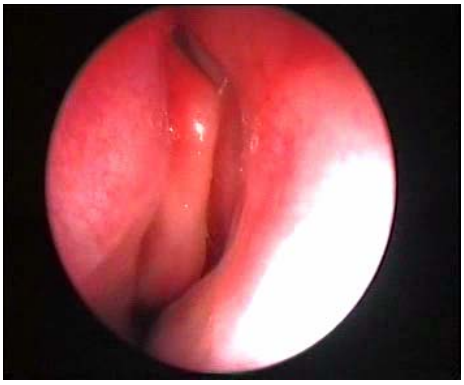
c. Osteotomy

d. Dissecting sac flap

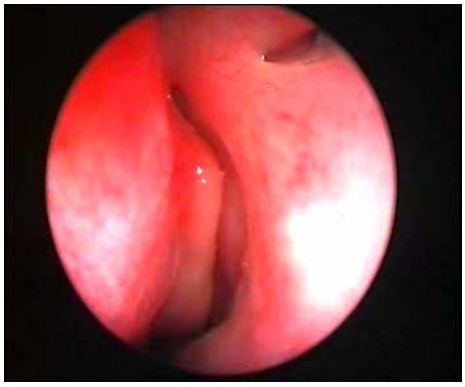
e. Anastomosis of flaps

f. Skin closure

SURGICAL STEPS IN ENDONASAL DCR

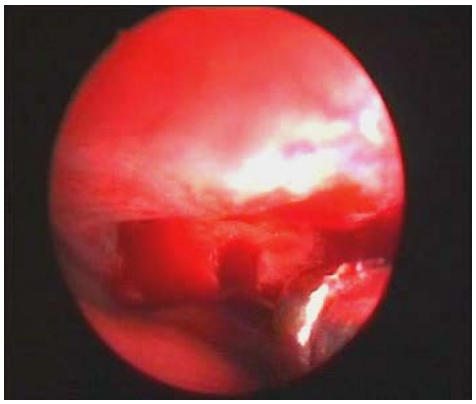


(a)



(b)

(c)



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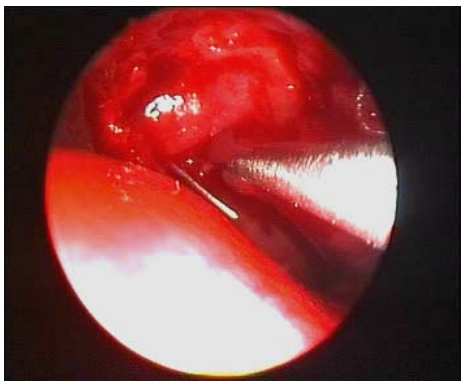
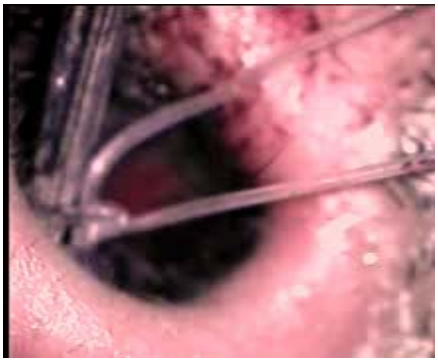


(e)



(f)

a. Endoscopic view of middle turbinate and meatus

b. Incising nasal mucosa

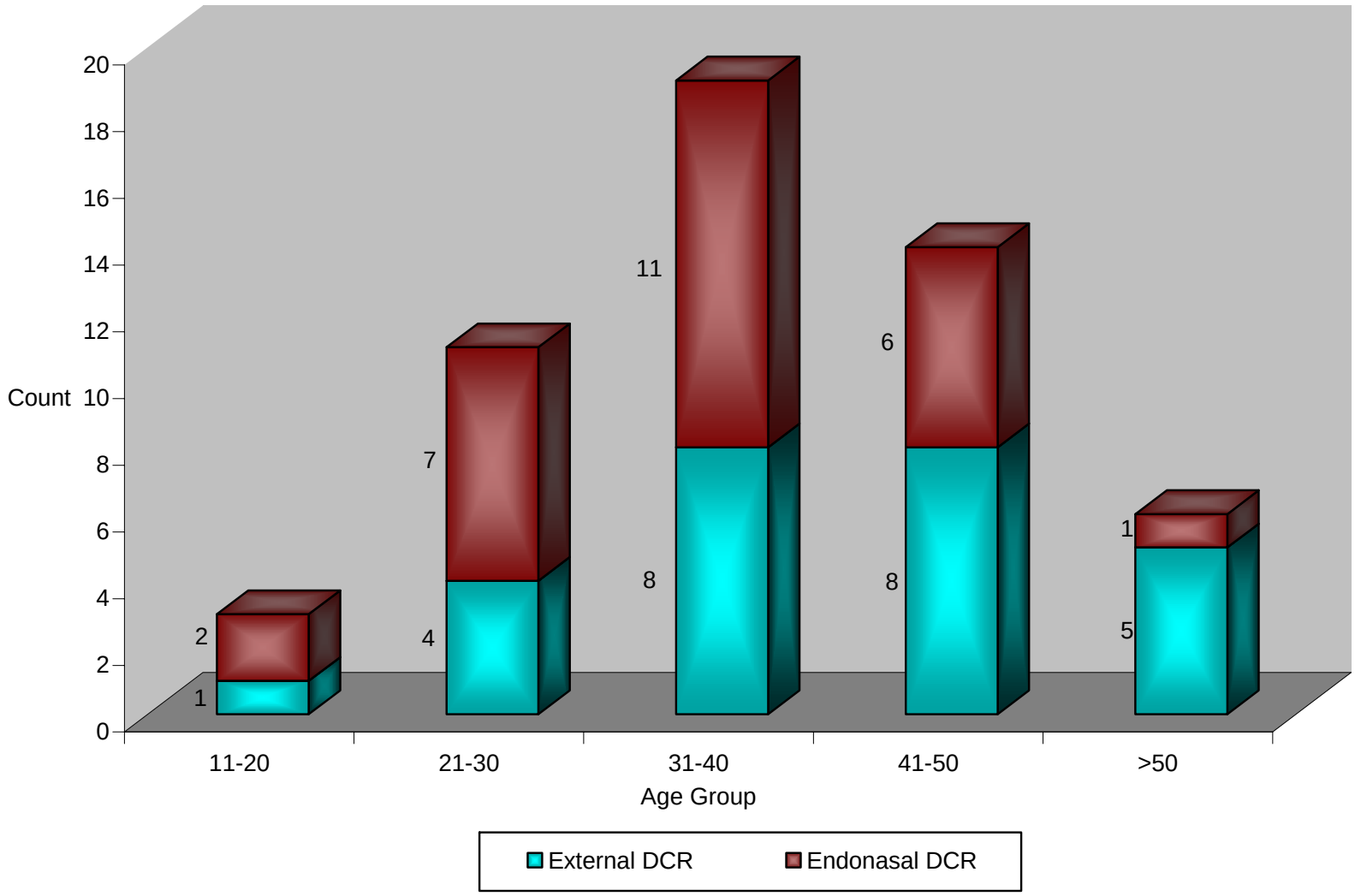
c. Removal of nasal mucosa

d. Osteotomy

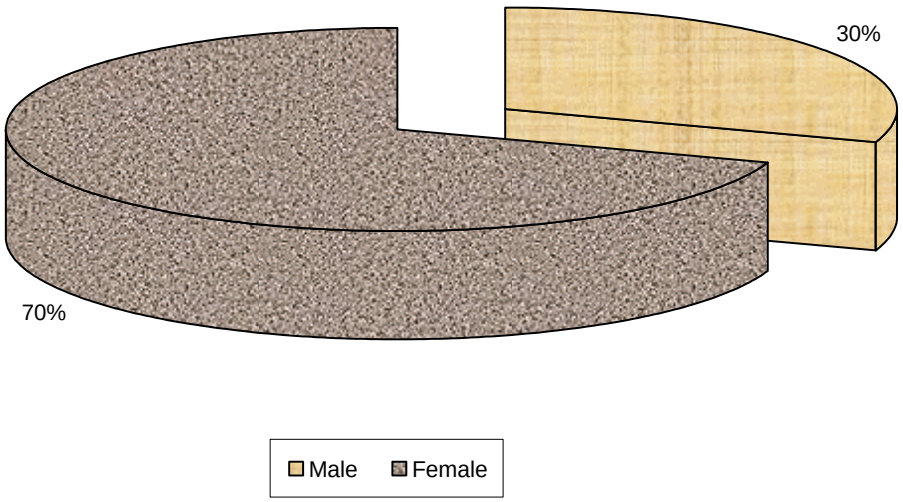
e. Incising sac mucosa

f. Securing the silicone tube to lateral wall of nose after intubation

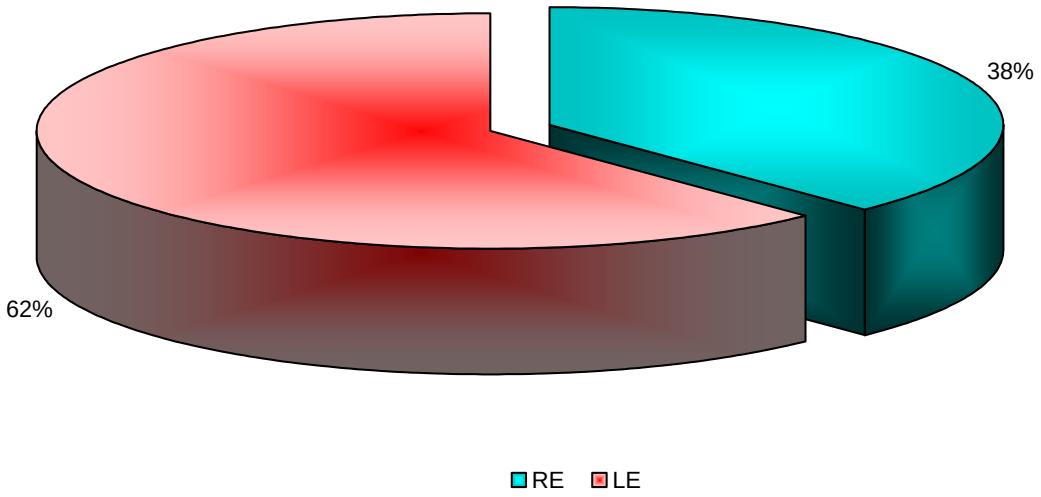
Age distribution

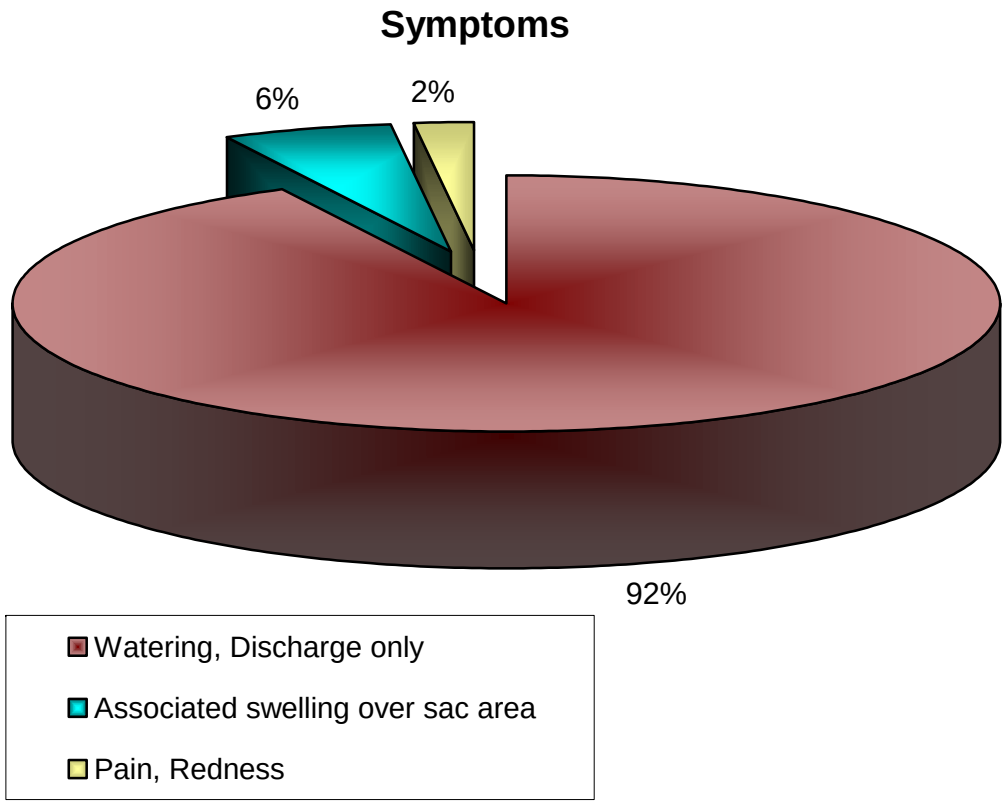


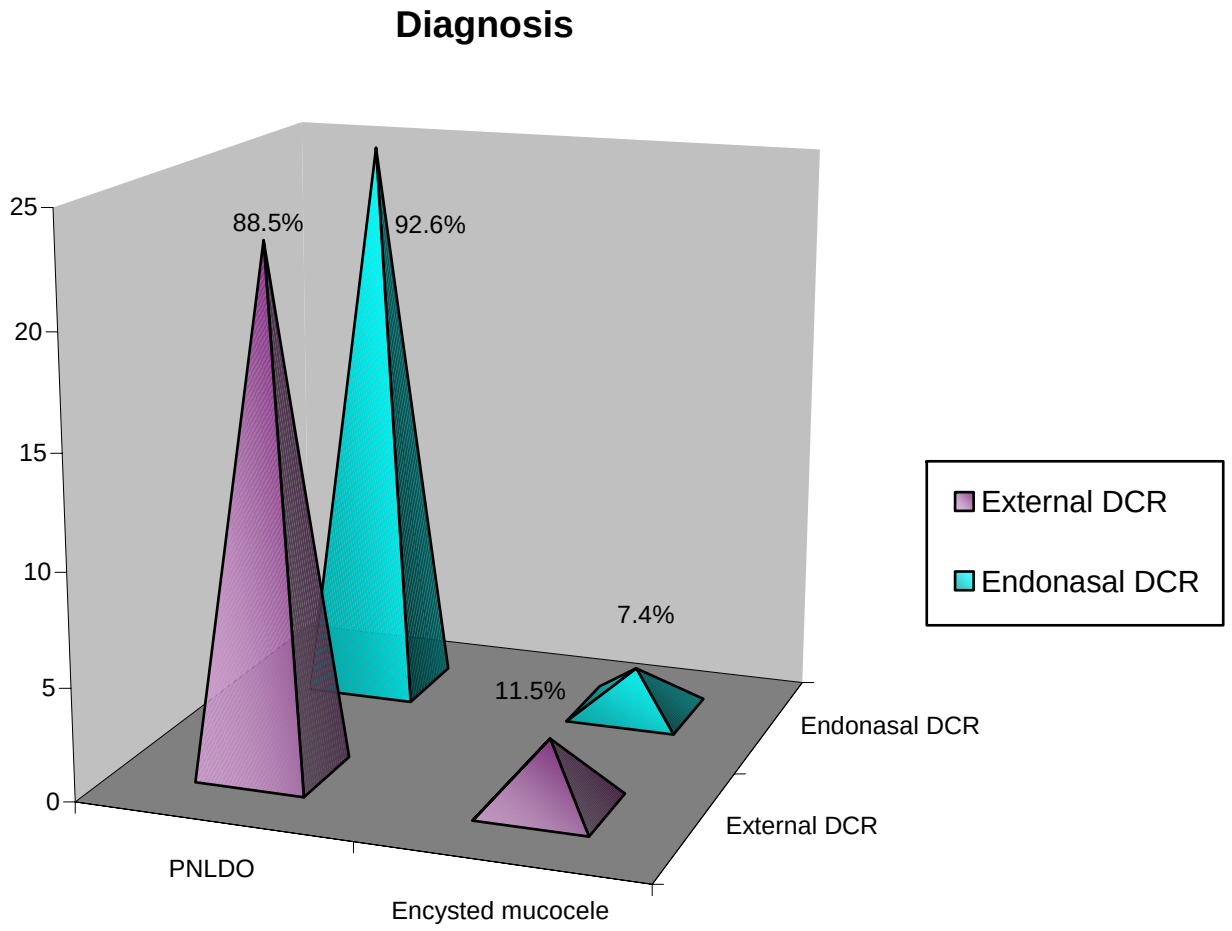
Sex distribution

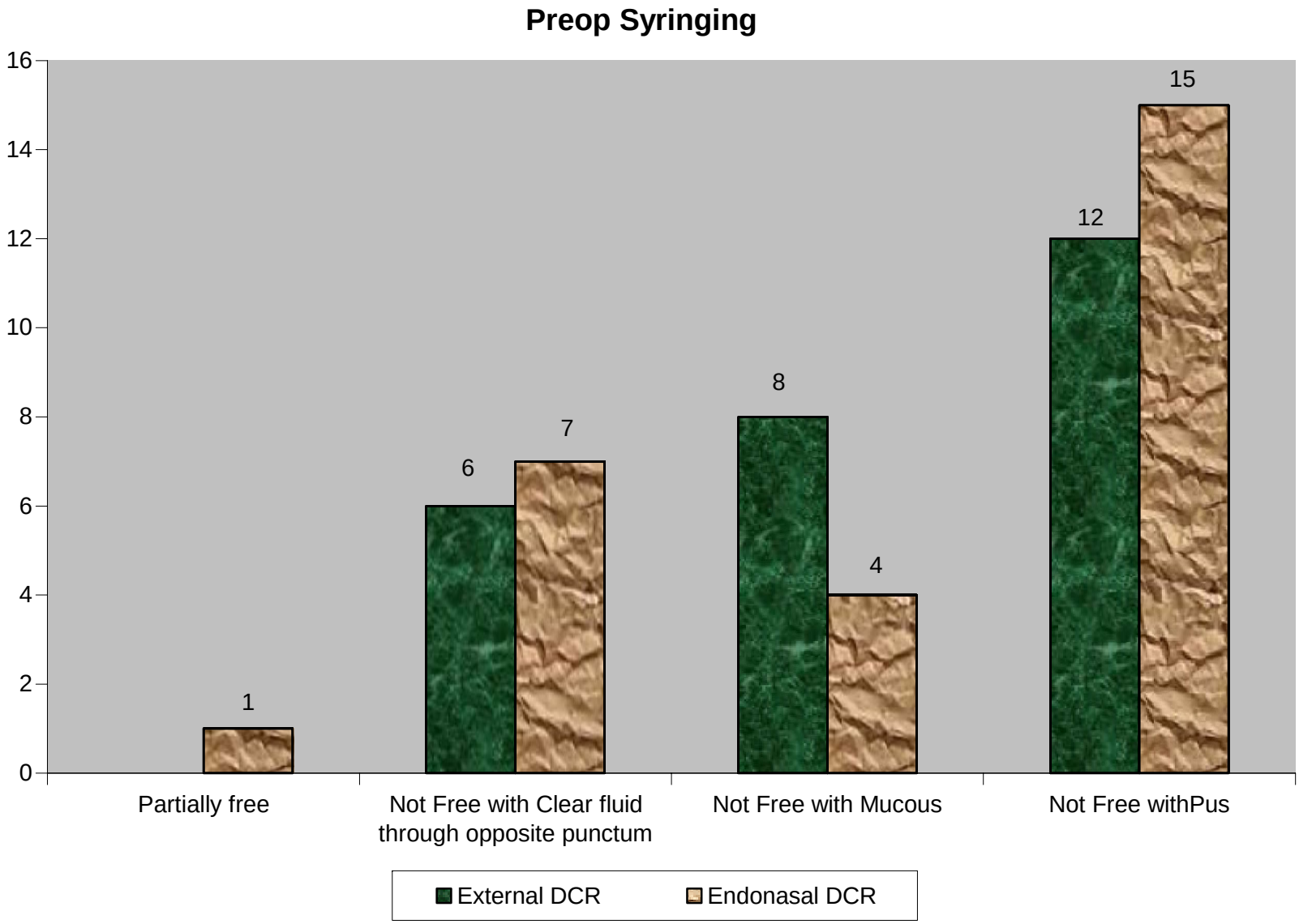


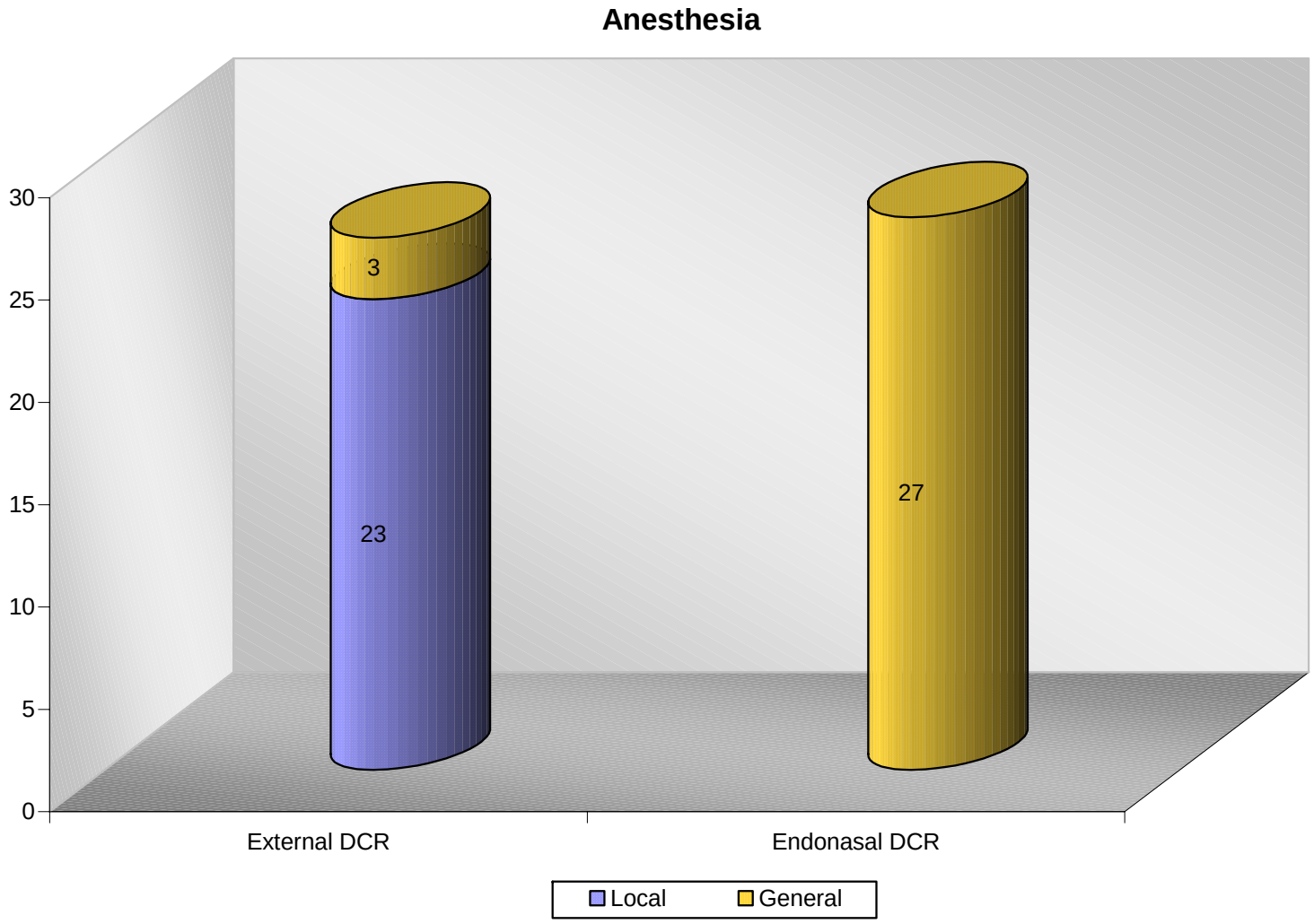
Laterality

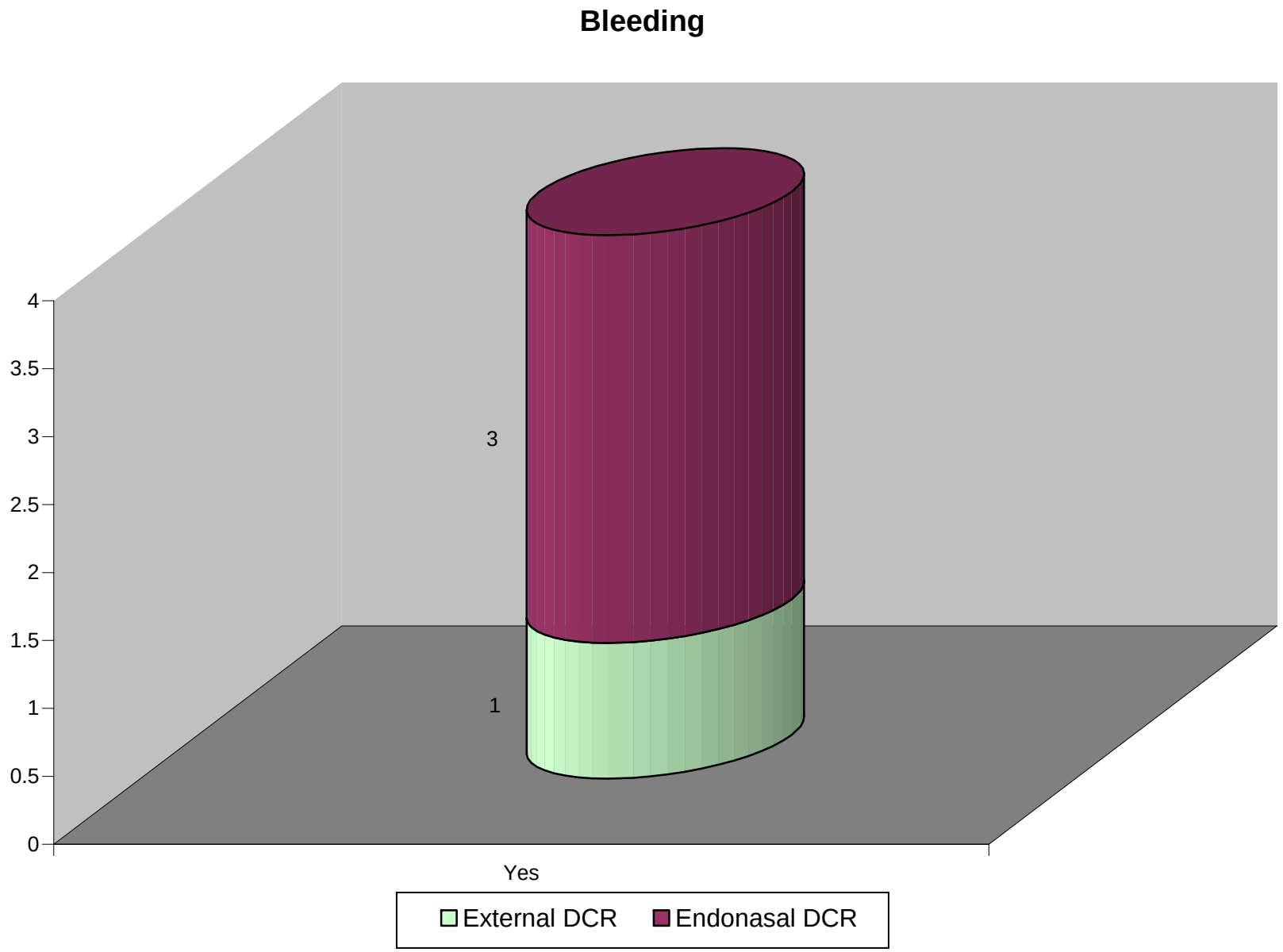


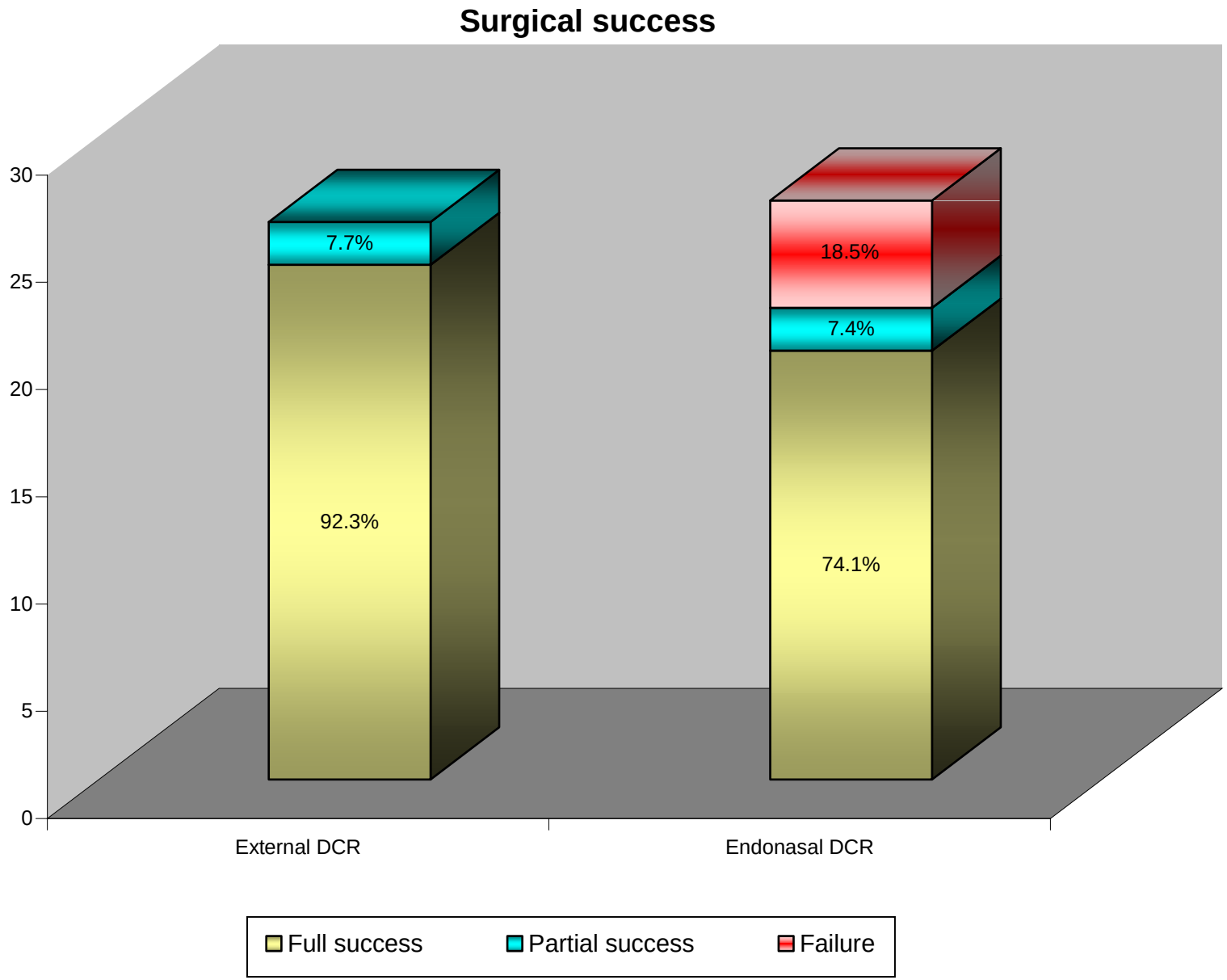

Symptoms
6%
2%
92%
Watering, Discharge only
Associated swelling over sac area
Pain, Redness


Diagnosis
25
20
15
10
5
0
88.5%
92.6%
7.4%
11.5%
PNLDO
Encysted mucocele
External DCR
Endonasal DCR
External DCR
Endonasal DCR

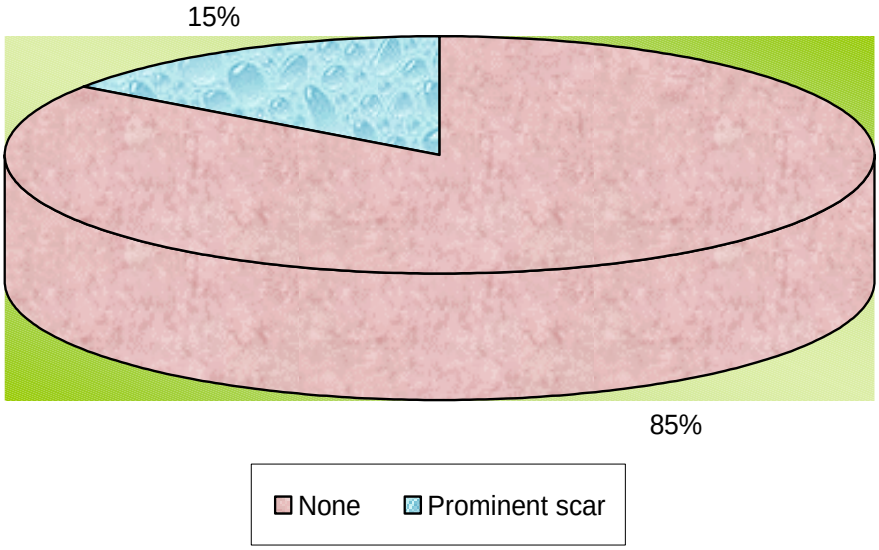

Preop Syringing
16
14
12
10
8
6
4
2
0
1
6
7
8
4
12
15
Partially free
Not Free with Clear fluid through opposite punctum
Not Free with Mucous
Not Free withPus
External DCR
Endonasal DCR


Anesthesia
30
25
20
15
10
5
0
3
23
27
External DCR
Endonasal DCR
Local
General


Bleeding
4
3.5
3
2.5
2
1.5
1
0.5
0
3
1
Yes
External DCR
Endonasal DCR


Surgical success
30
25
20
15
10
5
0
7.7%
92.3%
18.5%
7.4%
74.1%
External DCR
Endonasal DCR
Full success
Partial success
Failure

Postoperative Complications - External DCR



Postoperative complications – Endonasal DCR